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Engineering News-Record

Construction Marvels
At Hoover Dam

Economics of Protective Coatings for Pipe

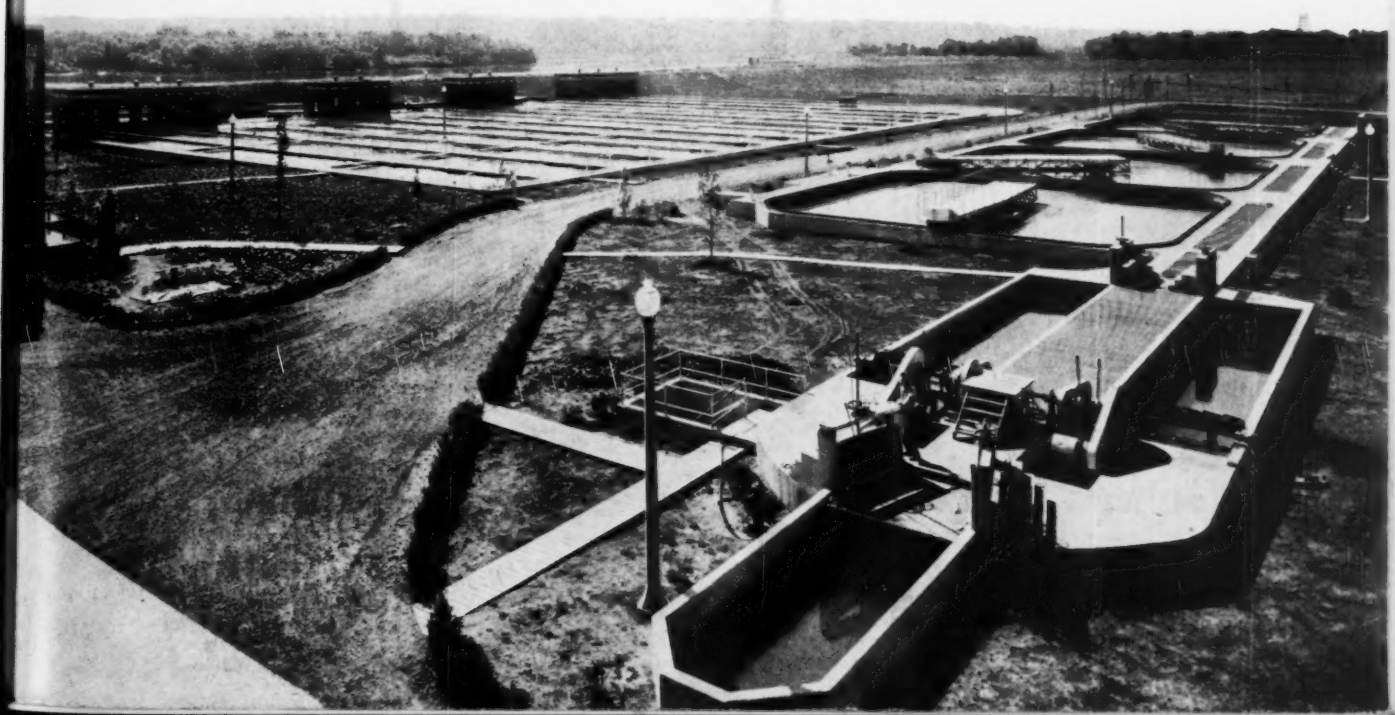
Industrial Railway Equipment
For Levee Building

How an Activated-Sludge Plant Was Started

Designing Casing Pipe for
Pipe Undercrossings

Research Work in Mass Concrete

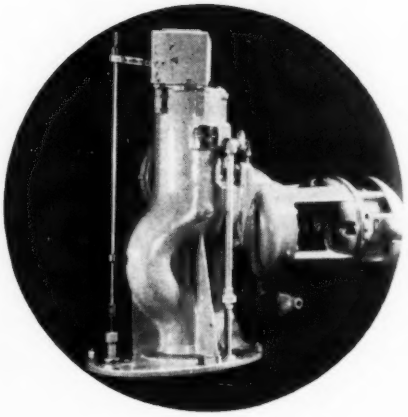
Activated-sludge plant at Peoria, Illinois, typifies the efficient layout for a medium-size city

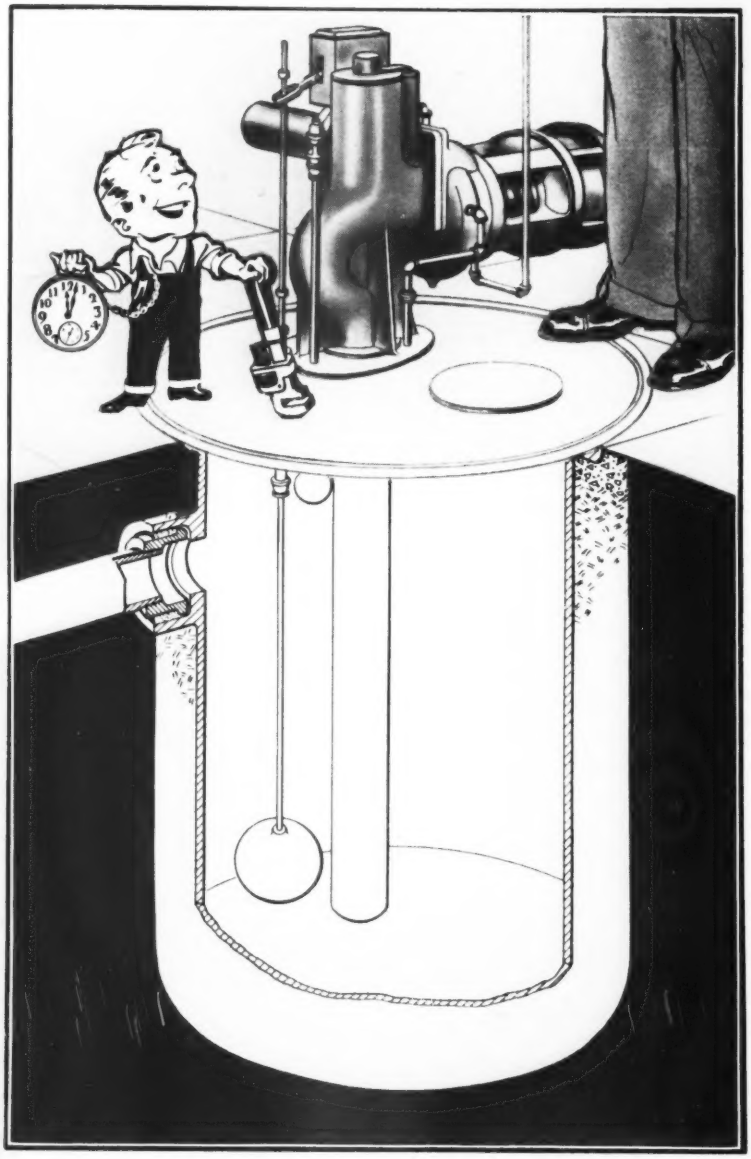


Only a Moment—

TO REACH ANY WORKING PART!

. . . No submerged impeller or thrust bearing in the Jennings Sewage Pump





Every working part, every bolt and every nut is readily accessible in this new Pedestal Type Jennings Suction Sewage Pump.

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Jennings Pumps

Engineering News-Record

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F. E. Schmitt, Editor

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The Spirit of Progress

AS IF in answer to those who claim that shortage of invention and creative advance is the root of our economic trouble, signs are increasing that a new spirit of progress is abroad in the land. Technical research is active in many fields, as in cement and concrete, where the Hoover Dam investigations are the day's high point; in steel, where welding and flame-cutting as well as the action of structures are under study; in brick, where several groups are working competitively to develop knowledge of material quality and reinforced masonry. There is similar new thought in subsoil exploration, covering geophysical measurement, sampling and laboratory measurement. And in many other fields of civil engineering the students are busily seeking for new facts and better knowledge. This is the seed from which springs great achievement in engineering construction. Research and development are good investment now as always, not only for him who undertakes it but for all; what the individual or corporation creates for personal advantage brings benefit to the entire community.

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Despots and Czars

WORKERS in the building field, particularly those belonging to well-managed unions, must view with alarm the harum-scarum, oppressive and often lawless activities of certain local union groups. These activities are in danger of placing the whole cause of unionism in an unfavorable light. They make enemies instead of prospective members of open-shop men. They tend to make industrial leaders bitterly antagonistic toward organized labor. But most reprehensible are the attempts of certain labor leaders to set themselves up as czars, with self-interest as the prime motive. In announcing a decision recently against Newark Ironworkers Union Local 11, Vice-Chancellor M. H. Berry of New Jersey eloquently stated the case: "The oppression of labor by so-called labor leaders," he said, "is a thousandfold worse than that of capitalism which labor unions were formed to resist." This oppression has put money in the pockets of the leaders, has given them power to place men in jobs or deny them work, and has in certain instances given them enough power to name the contractor on the job; it has without question increased the cost and decreased the efficiency of many union-labor jobs. It has given these leaders such control that they can carry on organized and vicious warfare against open-shop contractors to the point where murders are committed and police protection is required for every non-union worker. It is plain that unless the intelligent and farsighted labor leaders of this country do not curb such despotic methods, the union labor cause will suffer irreparably.

A Year at Boulder

BOX CARS come and go along the waters of the Colorado at the foot of the towering cliffs of Black Canyon. In ten months these cliffs have been pierced by four of the largest tunnels ever driven by man, and across the river gorge skips move silently on cableways over the waters through which Lieut. Ives pushed his frail boat 75 years ago. Trucks now rumble up roads cut in canyon walls where surveyors climbed perilously but a short time ago. The jackrabbit, monarch of the desert bordering the canyon, has seen a modern city of 5,000 population rise up. Power, life-blood of construction, comes surging over light aluminum threads hurriedly flung across a 225-mile wilderness of desert sage and mountain piñon. Such is the history of the first year in the building of Hoover Dam. The human effort and accomplishments of that year, the struggle against stifling heat last summer in the unprepared rush to put men to work, will not soon be forgotten. Nor can the phenomenal records made in driving the tunnels be ignored. The great initial difficulties in the construction of the huge project have been met and conquered during the first year; the engineers and contractors have written a bright chapter in construction history.

Awakening Interest

ENGINEERS are at last becoming actively concerned in advocating public works as a means of restoring the country to normal. A week ago we noted the action of the Michigan Engineering Society in urging such a program upon Congress; and a fortnight earlier somewhat similar action was recorded as having been taken at a meeting of the American Society of Civil Engineers in New York. The movement then started is beginning to take form. Last week two other events pointed toward increasing interest in an expanded program of public works as the way out of the present depression. Speaking before the Taylor Society in New York, two prominent economists both stated that large expenditures on public work—highways, water-supply systems, sewage-disposal plants and the like—should be undertaken in an effort to restore the purchasing power

of the low-income group; and American Engineering Council, heretofore unfriendly to a public-works program, sent broadcast extracts from a speech of Francis Lee Stuart, former president of the American Society of Civil Engineers, in which he stated that $20,000,000,000 could be spent to advantage on needed public construction, federal, state and municipal. The movement for a sustained program of public works needs wide support.

Preserve the Essentials

JUDGING by the controversy between those who would cut the costs of the national government by direct pay reduction and those who would do so indirectly by canceling vacation pay, it appears that no consistent attempt will be made to eliminate unnecessary government activities. Yet the continuous growth of federal functions in the last fifteen years suggests that at least some of them ought to be curtailed or abolished, and the present budget problem makes it quite pertinent to ask whether all the new things that the government does are really necessary. Particularly is this so because of the danger that various essential services will suffer in the drive for economy. No one will object to reduction of free services, increase of fees charged, or closer control of the output of printed matter; but it should be necessary neither to put the government on a part-time basis nor to destroy long-time values by stopping essential services in order to make ends meet. Three items of the federal functioning are vital to the public welfare: work whose continuity is essential, as stream gaging; operations that bear vitally on employment, such as the Hoover Dam construction; and the basic operating services. Discontinuance of any essential service would be a confession of bankruptcy—in either money or courage.

New Ways of Building

NOTABLE use of a new material is represented in the construction of the federal conservatory at Washington, where structural aluminum alloy forms a substantial part of the framing. Structural shapes of aluminum alloy since they became commercially available about five years ago have increased continually in favor and extent of use. Airplanes, rail cars and buses have benefited in weight saving. The shapes have been adapted to overhead traveling cranes and to long booms for Mississippi River draglines. In the building field the aggregate tonnage used has probably been appreciable, but no single structure contains a large amount, and until now none has used structural aluminum for major members. Selected for this structure to reduce maintenance charges from painting and corrosion, aluminum also contributes some saving from its light weight. Whether this is a net saving considering the increased cost of aluminum over steel the available figures do not show. But with the type of construction used—long curved cantilevers carried on steel columns—it is plain that the design permitted reducing the cost of the columns and anchorages. The work also afforded an opportunity for field and fabricating forces to acquaint themselves with the advantages and limitations of the material, such as the difficulty of shearing, the ease of punching and the careful control required in rivet heating, all of which were commented upon in an article last week. Further major applications of structural aluminum in the building field will broaden the practical knowledge of this new material and will supply the necessary test of practical service.

Seven-Fifty Per Room

FROM out the medicine-shelf of panaceas prescribed against the pains of business depression, large-scale housing stands forth prominently. Rightly its possibilities lay hold of the public imagination. As a business remedy it is probably no more potent than some others—expanded public works, for example. But serious consideration of what can be done to provide adequate housing is long overdue, regardless of business conditions.

Decent housing for the masses is not a new subject to the field of social thought. Nor are economists, bankers and builders strangers to its problems, although their views have too often been colored by the rose-tinted glasses of speculation. For years proper understanding of the housing problem has been confused by speculative and political legerdemain on the one hand and by sentiment of the own-your-own-home type on the other. Now, under the stress of adversity, the essentials of the problem are being brought into bold relief as capable planners and builders are looking to housing as a sound investment for their brains and funds. Things are happening in the housing field.

First and foremost is the realization that it is the low-income group that needs housing, and that those receiving $1,000 to $1,500 constitute the great mass market—nearly half of the total population—that must support large-scale low-cost housing activities. The 5 per cent who receive over $2,500 are fairly well provided for, while the 40 per cent receiving less than $1,000 are under present conditions impossible to reach. In the middle group the $30-a-week worker predominates, and his rent of $30 per month sets the objective. To purchase a home on such a monthly allowance is out of the question. To rent a four-room apartment requires that it be available at $7.50 per room per month, which at present also is out of the question for decent living quarters.

So we have the problem: Seven-fifty per room must be substituted for the ten dollars now considered as ultra-low-cost housing. Lower-cost housing than has ever been considered possible must be provided, first by securing cheap capital in substantial amounts, second by assuring the assembly of large plots of land at reasonable prices, third by cutting construction costs far below their present deflated levels.

These are the specific requirements; but they in turn rest upon one that is even more fundamental—assurance of stability of the housing development and the neighborhood in which it is located. Lack of stability is behind the shameful and uneconomic blighted areas of our large cities. Instability has transformed residential areas in smaller cities and large city suburbs into run-down satellites of haphazard groups of factories. At a time when capital needs housing and housing needs capital, lack of stability has frightened capital away because there is no assurance in any housing development that obsolescence from blight may not be just around the corner.

Stability is the starting point. It can be assured only by governmental help, but once assured capital as well as tenants should be attracted to low-cost living quarters. Building capital is accustomed to risk, but only at a high probable rate of return; reducing the risk by irrevocable zoning, by state aid in condemnation of land, by long-time planning of transportation and street facilities—in short, by stability—will make a lower return acceptable.

Large-scale low-cost housing, too, will require a more united and autonomous building industry, a recognition

of the social need of the improvements in order to temper speculative desires, concerted and cooperative research into materials and methods of construction, and an approach to complete mechanization and therefore lower cost of the field operations of building.

Conditions for bringing these things about were never more propitious than they are at present. A sensible approach to the housing problem, as a business instead of a sentimental wish, can provide the great masses of our population with those modern advantages of which we boast but which actually are enjoyed by the relatively few. Rebuilding of our cities may prove to be a sizable factor in economic recovery. But the situation squarely challenges city planners to forget the beauties of Paris and Washington for more practical things, and the building industry to prove itself to be not a mere fair-weather performer but a leader in times of stress as well.

Significant License Law Changes

CHANGES in the education law of New York State as it affects the professional practice of architects and engineers became effective on March 29. They are significant nationally, first because they mark an advance in the development of professional license laws, and second because they end an unhappy controversy between the architectural and engineering professions in New York State. In some respects the latter effect is more important.

The controversy between the two professions in New York State centered around attempts to set up definite limits to the practice of each, efforts which were successful to the extent of excluding engineers from the multiple-dwelling field and were almost successful in excluding them from all parts of the building field except industrial buildings, warehouses and power plants. Attack upon these exclusions by engineers led to a counter-proposal by architects for segregation of structural engineers, much as is done in California, permitting them to practice freely in the building field. Agreement finally was reached early this year upon the principle that no attempt should be made to set up any line of demarcation between the two professions or to delimit a zone of common practice. This was the ideal basis for settling the difficulty between the professions.

Definite progress in the development of sound and effective engineer license laws also is recorded by the changes made in the New York education law. As revised, the law contains a definition of engineering which is a reasonable approach to the ideal definition—not yet written. The definition is the result of a careful study of the many proposed to the national joint committee charged with drafting a uniform registration law. The revised law also clarifies the definition of what constitutes the practice of professional engineering and goes as far as it can toward checking misuse of the term "engineer." Its use by those who would give the impression that they are qualified to practice professional engineering is now clearly prohibited.

As a piece of license-law legislation, the New York State law now is superior to the uniform registration law sponsored by several national and local engineering societies. The work of transforming it from a crudely drawn, indefinite and largely unenforceable law with extremely low qualifications to a workable law with standards dictated by present-day professional requirements has been tedious and discouraging, both because of the inertia of the profession as a whole and because of the definite opposition of self-interested groups within the profession. The controversy which developed with the architectural profession added greatly to the problem.

In the end, however, the latter conflict served a useful purpose. Beginning as a purely local matter it became so bitter and bore so directly upon the fundamentals involved in the relations between the two professions as to compel men of national prominence in both professions to take cognizance of the conflict. In the end they forced the adoption of the high ideals which are the basis of the agreement reached in February of this year, when both sides gave their approval to the changes now accomplished. Relations between the two professions have been greatly improved, each has learned to know and appreciate the other's problems, and both have come to the realization that their hope lies in cooperation .

Comment by this journal upon what is hoped to be the closing of this long controversy between engineers and architects would not be complete without a word of appreciation of the fine spirit shown in the latter negotiations by members of the architects' registration board, men whom in the past we singled out for criticism of the stand they then took. Much credit must be given also for the helpful cooperation of Robert D. Kohn as president of the American Institute of Architects, and H. H. Horner and Charles B. Heisler, of the state department of education. Final solution of the difficulty is due in no small part to the tact and diplomacy of Dr. Horner and his firm insistence that the professional laws be regarded not as legislation to advance the selfish interests of the professions but only as a means of protecting the life, health and property of the people of the state.

Rail Study Under Way

PROGRESS on an intensive rail study undertaken jointly by rail manufacturers, the American Railway Association and the Engineering Experiment Station of the University of Illinois was reported upon at the American Railway Engineering Association's meeting in Chicago recently. Announcement of this study, to last at least five years and to cost on an average $50,000 a year, was made at the A.R.E.A.'s annual meeting last year. It marked the end of much aimless buck-passing between rail manufacturers and railway engineers as to the cause of rail failure.

An order for several thousand tons of 130-lb. rail for this study was placed during the year by the committee in charge of the study, the order being divided among four mills, and detailed records of the manufacturing processes were made by each party to the agreement. Out of this order the top, middle and bottom rail of the middle ingot of each heat was shipped to the University of Illinois, where the testing for the investigation is to be done, and the remainder of the order was delivered to the Baltimore & Ohio R.R. for installation in sections of track where careful checks can be kept upon the service performance of the individual rails. Orders for a like tonnage of 110-lb. rail for installation in track on other railroads have now been placed.

No conclusive results are to be expected from these tests for several seasons. It is desirable, however, to record the fact that this much-needed study actually is under way, and to congratulate the men who have the courage to go ahead with a costly research program of this kind under present conditions in the railway field.

A Tale of Construction Marvels at Hoover Dam

A city of 5,000 built and populated, a construction plant whose capacity is recorded in thousands of units a day, and a railway and highway system created in twelve months on desert plateaus and in rocky canyons

A BROAD PICTURE of construction progress at Hoover Dam, as seen by the editor on his third visit a year after work was begun, is presented in the following article. A miracle of activity and accomplishment has come about since the first visit a year ago and even since the second visit, when the first construction year was half over. The stories of these visits have been told in *Engineering News-Record* of May 28 and Dec. 10, 1931. Notable as were the activities they presaged, they scarcely indicated the heights of energy applied in construction that the Hoover Dam operations now exhibit. Thus an account of a third visit contains little that has been previously told and much that could not then be told because it did not exist. The article that follows is the narrative of a day's trip to the new city created for the builders of the dam and those who serve them, and to the many units of construction operations, which for miles bead the canyon of the Colorado and the plateau above it. It is a story of a rapid engineering inspection and not of details of plant and construction procedure. These details have been or will be given at other times as indicated in another place. The map and views add vision to the telling of a most interesting story. —EDITOR.

ENTERING Las Vegas, the logical starting point for a visit to the Hoover Dam, one finds a quieter and more orderly city than there was a year ago. The population, as given by the Chamber of Commerce, is 9,000. A year ago the streets were lined with dilapidated cars bearing families and household possessions. They are no longer a sight, and the railroad park is occupied by a mere score of sleepers instead of hundreds. The stores have developed a more substantial look, and a new three-story hotel is about ready for occupancy. A spirit of progress and a certain deference to the position of national prominence assumed in becoming the gateway to Hoover Dam are manifest. Even the gambling places, which a year ago were boisterous and crowded at all hours under the stimulus of the then-new Nevada wide-open gambling law, are quieter. However, all is not contentment.

The headquarters of the contracting organization and the Bureau of Reclamation have been moved to Boulder City, with the effect of bypassing much activity directly to the new town. An undercurrent of mild resentment is evident in the mercantile section of Las Vegas because of the growing commercial activity at Boulder City. The long-awaited boom of Las Vegas is being shared with the new upstart, and the result is dissatisfaction. Proper community cooperation would help both places in keeping to themselves the windfall of government money. Assuming that the 3,000 employees of the Six Companies are earning an average of $5.50 per day, the payroll amounts to about $500,000 every 30 days, and it is certain that competition for this purchasing power will develop in centers much farther removed than Las Vegas.

To Boulder City

The route to Boulder City is by a fine oiled highway running straight southeast for nearly 19 miles to Railroad Pass. The raw desert without sign of human habitation still extends on both sides to the distant ranges colorful in the morning sun, but the roadside has sprouted an indescribable growth of filling stations, lots-for-sale establishments and desert speakeasies, with such picturesque names as The White Mule Corral, Blue Heaven, and Purple Sage.

Climbing an easy grade to an elevation about 500 ft. above Las Vegas, the highway crosses through Railroad Pass and intersects the new branch of the Union Pacific, which approaches the pass from the west. A short distance beyond is the U. S. Ranger station, the official portal of the government reservation, where all cars are stopped and the occupants are queried as to the purpose of their visit. Passes are issued to those on business trips or to tourists.

Four miles farther the highway approaches Boulder City. On the left lie the extensive yards, shops and equipment depot of the contractor, Six Companies, Inc. Along a railroad siding are piles of lumber with the large carpenter and framing shops. The size of the main machine shop may be judged from the standard railroad locomotive undergoing repairs on the tracks inside the door. It is here that Six Companies does all its heavy machine work, rebuilding of equipment and major repairs.

Boulder City

From the shops the road swings to the right into the town, which spreads out across the gently sloping desert. At this point a close inspection may profitably be delayed to permit a ride up onto the hill overlooking the town for a general survey. The change from a year ago appears almost miraculous. From this vantage point the town site was marked at that time only by a warehouse at the end of the railroad track, some

Section of the extensive shops and yards of the contractor where heavy framing and repair work is done.

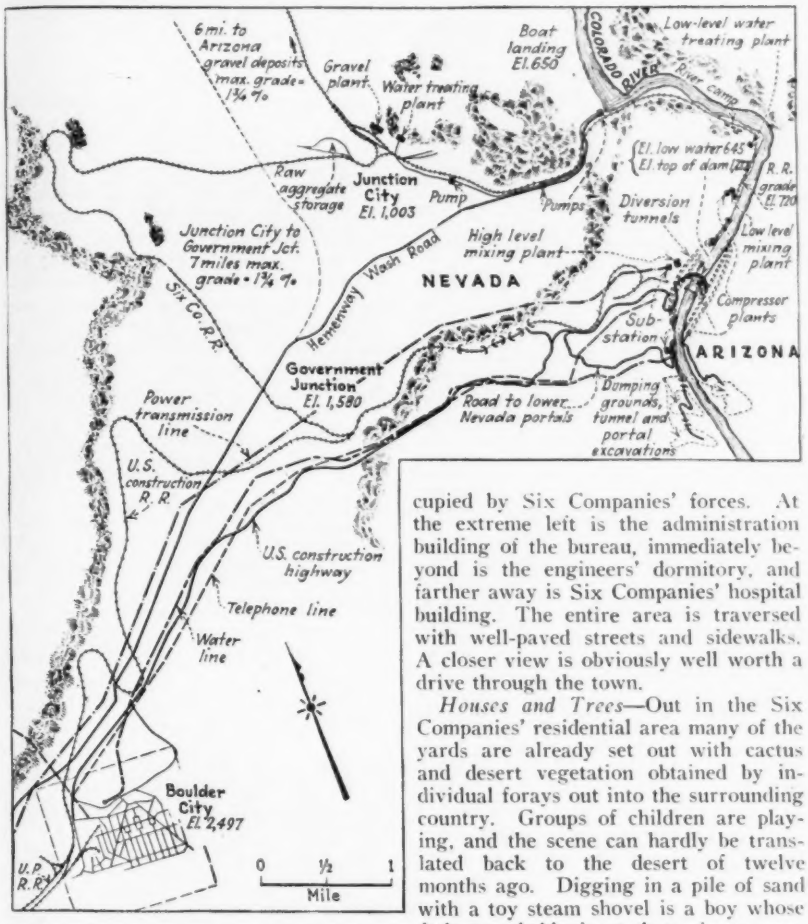
Present center of Boulder City commercial activity, the big general store of the Boulder City Co.

temporary shacks housing the contractor's crews engaged in putting up permanent buildings, and, far out across the desert, survey parties engaged in staking out future streets. Today the same area is occupied by about 5,000 people living in comfortable homes and provided with all the conveniences of a modern city.

To the right lie the large dormitories, mess hall and administration buildings belonging to the contractor. Directly in front is the group of well-built and attractive dwellings occupied by the

Where the silt-laden Colorado River water is turned into a soft clear municipal supply. The plant started operation early in March.

Laying the last street surfacing on the original contract for municipal improvement. Further street work will be necessary.



Map showing travel route taken and the locations of Boulder City and the various units and construction operations now in progress.

administrative and engineering forces of the bureau. The middle distance is at present the principal scene of activity, for here the business district of the town is being built. In this section is located the completed city municipal building, which contains the office of the city manager, the U. S. marshal, the jail and the postoffice.

The distant streets outlining the residential district are lined with orderly rows of hundreds of two- and three-room neatly stuccoed dwellings built and occupied by Six Companies' forces. At the extreme left is the administration building of the bureau, immediately beyond is the engineers' dormitory, and farther away is Six Companies' hospital building. The entire area is traversed with well-paved streets and sidewalks. A closer view is obviously well worth a drive through the town.

Houses and Trees—Out in the Six Companies' residential area many of the yards are already set out with cactus and desert vegetation obtained by individual forays out into the surrounding country. Groups of children are playing, and the scene can hardly be translated back to the desert of twelve months ago. Digging in a pile of sand with a toy steam shovel is a boy whose father probably is at that minute operating the huge electric prototype in the canyon.

Following the shoppers toward the business section, the principal establishment is found to be the large general store, complete in every department and operated by the Boulder City Co., a Six Companies' subsidiary. Many other stores to be operated by individuals under government permit are being constructed, and a few are already open. Walls for a movie theater are going up, and the first church structure is under way, although three religious groups are already holding regular services.

From a well-stocked temporary nursery, government forces are setting out trees along all the streets and in the parking areas and a variety of shrubs and plants around the public buildings. This work will go a long way to relieve the desert aspect that still persists regardless of the human activity.

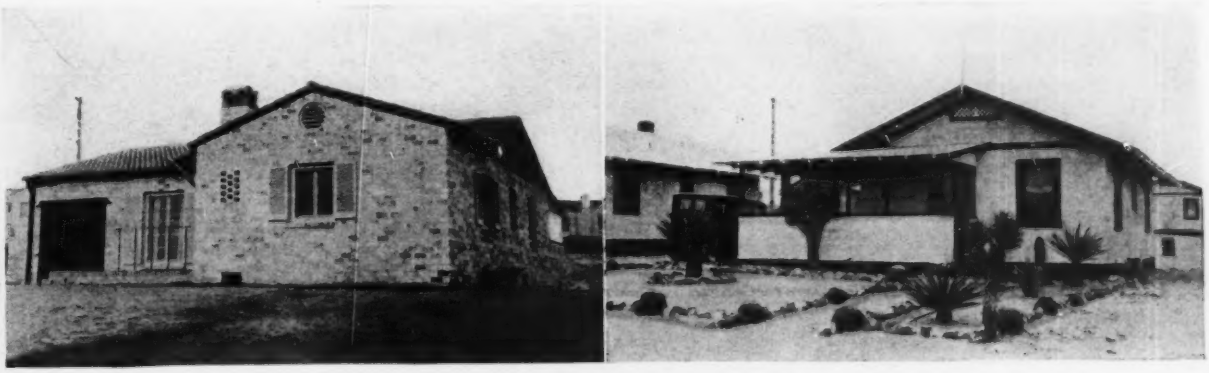
School facilities are crowded at present, but an eight-room elementary school building will be started at once by the government. High-school facilities probably will continue to be arranged by bus transportation to Las Vegas.

The red brick building near the end of the railroad track houses the municipal filtration plant, which, although just beginning operation, is producing a high-grade supply from a most difficult raw water.

To the river

Aggregate Plant — About 2 miles from town the route to the plant turns off the main government highway to the dam site and down Hemenway Wash. This 5-mile stretch of construction road in the wash has been shaped up and oiled by the contractor. On a large flat area about 2 miles from the river is the aggregate grading and screening plant designed to handle a minimum of 500 tons of gravel per hour, with provisions for doubling this capacity if necessary. Wash water is pumped from the river to this location and desilted to 500 p.p.m.

The pit-run gravel is brought in by train and either run through the plant and placed in live stockpiles or stockpiled in its original condition on a large area near the plant. The raw stockpile already contains about 100,000 cu.yd. of gravel, and the finished product is being turned out in small runs to tune up the plant for its first major use in furnishing aggregate for the tunnel-lining concrete. The pit-run material may be graded by either a wet or a dry process into sand and four sizes of coarse aggregate. As it is needed, it is reloaded into railroad cars for transportation to the concrete plant 4 miles



Typical residences: left, recently completed house erected by the government for employees; right, older house of a Six Companies' employee, where landscaping with desert plants is most effective.

Ready for the grading of aggregate for 4,300,000 cu.yd. of concrete. This plant can operate either dry or wet, turning out sand and four grades of coarse aggregate. It was designed so that its present capacity of 500 tons per hour can be doubled without interruption of operations.

away in the canyon. Leaving more detailed treatment of the plant and its operations to subsequent description, the trip continues on up the river for a quick look at the gravel-pit operations.

Gravel Pit—The rough construction road parallels the railroad line for about 5 miles to a timber-pile trestle across the river. The road is not built for hauling, as transportation from pit to plant is by the railroad. A gravel train passes, consisting of eight 30-cu.yd. side-dump cars pulled by a 90-ton steam locomotive. Out onto the railroad trestle the road leads across the river to the Arizona side. This trestle, about 850 ft. long, was built after considerable study, as the most feasible means of transporting the material across the river.

The possibility of belt conveyors from pit to bunkers on the Nevada side was considered and rejected because of the cost of rehandling and the difficulty in moving the loading equipment in the pit. Although of substantial construction, the trestle may go out during the high-water season, but the cost of four trestles is estimated at less than the cost of the conveyor installation. The raw stockpile at the plant will take up the slack during the time the bridge is likely to be out.

Out across a wide flat area, conspicuous by the almost total absence of vegetation, is the gravel deposit. Here a 5-yd. dragline is stripping and loading a train. Operations have been started at the river side of the pit on account of accessibility and ease of disposal of stripped material. The top 2 to 3 ft. is being stripped, although occasional layers of silt are encountered at lower depths in the pit. The average depth of stripping is estimated to be about 2½ ft.

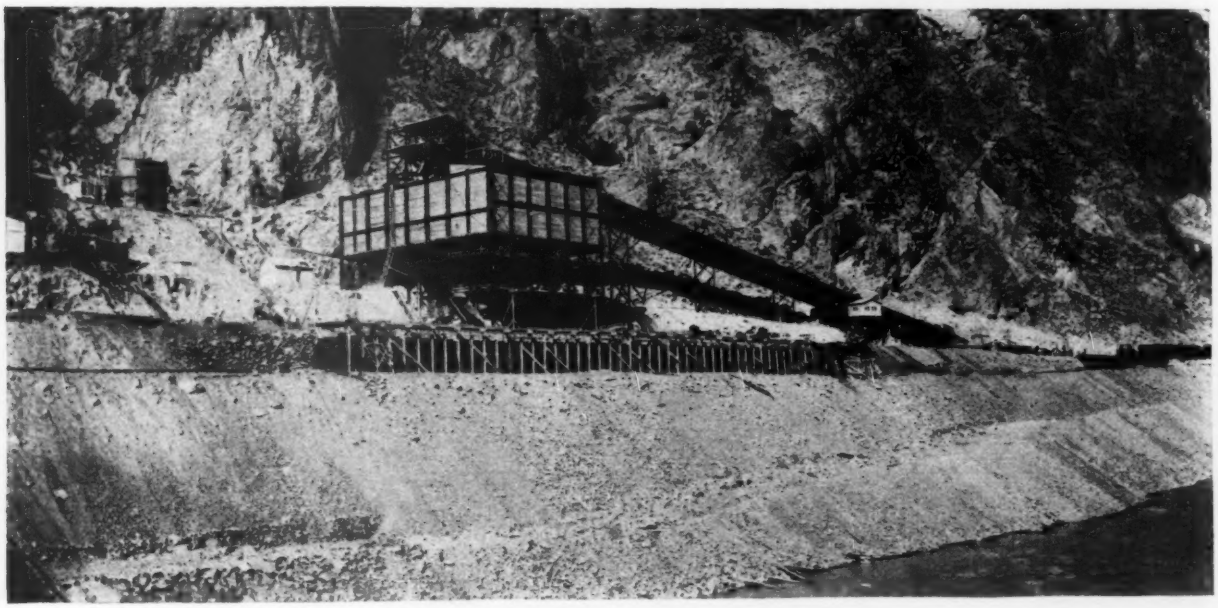
Housing four 4-yd. mixers, this concrete plant at the low-level location on the Nevada side, ¼ mile upstream from portals of diversion tunnels, will be used for the tunnel-lining concrete and lower part of the dam until storage begins. Aggregate and bulk cement will arrive by train, and concrete can be delivered either by truck or by train. This is a telephoto view from across the river.

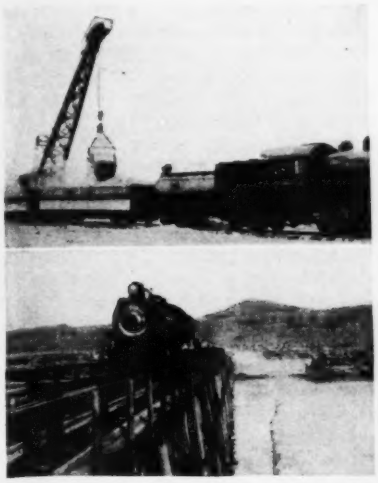
Into the Canyon — Back across the river, past the aggregate plant and down into the upstream end of the canyon the road leads past the famous Ragtown. Here, since the beginning of activity, several hundred people have camped in various degrees of poverty and inconvenience, either waiting for the work to start or, since then, continuing this existence even though employed, as a supposed means of economy. By government order this community will be eliminated after April 1, and all those within the reservation will be required to move into Boulder City. This will remove a possibility of epidemics where conditions are unsatisfactory and not under control.

DISPOSITION OF CONSTRUCTION FORCE ON MAIN CONTRACT

Tunnel workers	1,300
Miscellaneous river operations	272
Low-level mixing plant	78
Spillway work	162
Mechanical department	309
Electrical department	49
Railroad, including track crews	124
Gravel plant and pit	79
Boulder City construction	144
General (engineering, office, warehouse, hospital, etc.)	116
Total (Six Companies)	2,633
Subsidiaries	222
Subcontractors	134
Grand total	2,989

On into the canyon the road passes the buildings of the contractor's river camp occupied by about 500 employees. In the main, this camp houses men of the older school who shun the sight of white collars and skirts on a construction job. To them the river camp appeals, where facilities of room and board are as nearly as possible identical with those provided in town, but the inroads of civilization as presented by





Bringing in pit-run gravel: above, loading train with 5-yd. dragline; below, gravel train of eight 30-yd. cars crossing river. These operations are running three shifts.

Boulder City environment are not so apparent.

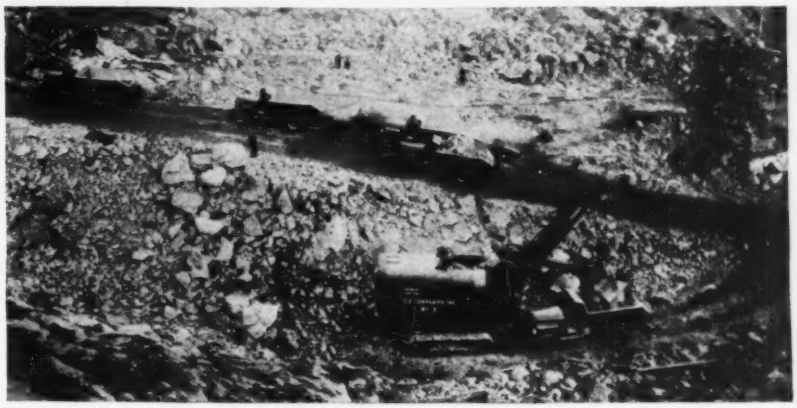
Concreting Preparations — A mile farther is the low-level concreting plant ready for operation. Here concrete will be mixed for tunnel lining and for the lower portion of the dam up to the time when storage of water in the reservoir is required; then the plant will be removed to a higher elevation. The present set-up includes four 4-yd. mixers with the elaborate batching equipment described in *Engineering News-Record*, April 14, 1932, p. 534. Aggregate brought by train will move to the bins above the concreting plant by belt conveyor, and bulk cement will be lifted by pneumatic equipment to the cement bins.

From the plant concrete can be taken by either train or truck to the upstream tunnel portals and later to the dam. The concrete plant is at present the end-of-rail of the contractor's line into the canyon. The two 1,000-ft. tunnels required to extend the line to the dam site have been driven, however, and one is being used by truck at present. Through this bore, passing a steady stream of loaded trucks from tunnel-mucking operations, the road reaches the four upstream portals of the diversion tunnels. This point marks a present concentration of activity.

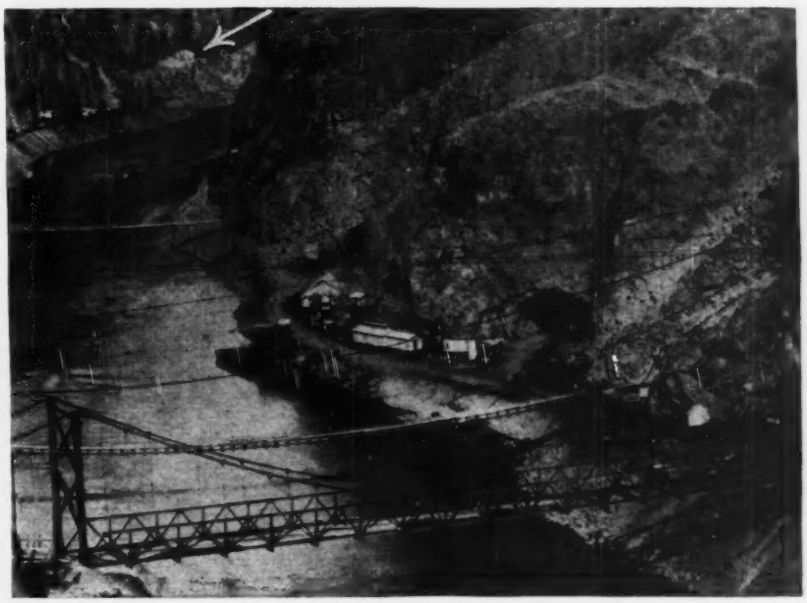
Upstream Portals — Trans-river trucking is across a steel suspension bridge above high-water level and a temporary timber-pile trestle used during low-water period. The recent flash flood carried away the original trestle in this location, but it was replaced in a couple of days, which indicates the speed and magnitude of the contractor's incidental activity. At the mouth of the inside Nevada portal in deep excavations are forms where the first "pay concrete" was recently placed as the foundation for the permanent-intake trash-rack structure. This trash-rack foundation will also be used temporarily as the foundation for the contractor's concrete-arch cofferdam to be built to protect the tunnel portal during the high-water season. Foundations for the other seven of these arch diversion dams at the tunnel portals have been built, and the structures will be completed as the regular high-water season approaches. Ramps over these dams will permit lining operations to continue during high water.

Across the river in the portal of the inner Arizona tunnel, preparations are under way for starting concrete-lining operations. In this heading the tunnel has been excavated completely, including removal of the invert, and concrete sills have been poured along the top of the invert section. These will carry rails for gantry equipment that will be used to place the invert concrete. A subsequent operation will pour the walls of the tunnel by direct placement by bucket through the side-wall forms, and finally the arch section will be placed by pneumatic process as the last step in tunnel lining. Concrete will be brought from the plant by trucks with agitator bodies. Plans for these operations are not final at this time.

A steady stream of trucks can be seen coming out of the mouth of tunnel No. 1, where bench enlargement is still under way, and out of the portal of tunnel No. 4, where invert excavation is in progress. Some rock from the Arizona headings has been deposited upstream and above high-water level on that side of the canyon, but the majority of the tunnel material from these four portals



Typical excavation in open-cut, where 300,000 cu.yd. of rock will be removed for the spillway on the Nevada side. Shovel and trucks were available as tunnel work neared completion.



Activity at the lower portals centers on tunnel driving. The suspension bridge will allow uninterrupted trucking across the river even during high water; this structure is duplicated at the upstream portals. The downstream portals on the Arizona side are shown enlarged and ready for removal of the 16-ft. depth of invert. At the upper left are the buildings at the mouth of the Nevada adit, and the arrow shows the lower portal of the second railroad tunnel, which will provide railroad transportation to the site from the upper end of the canyon.

has been trucked upstream on the Nevada side, where it has been used to provide the railroad fill around the bend of the canyon.

At present three cableways are operating overhead, one of 10-ton capacity for heavy equipment and two of 5-ton capacity for lighter work. Anchorages are being prepared for the 20-ton cableways, which will be used for handling equipment and concrete on the dam itself.

Downstream portals

Except by boat or by long hike through the tunnels, there is no direct route at present to the work at the downstream portals because of wall-scaling operations. This necessitates a return out of the canyon, a climb to the government highway on the rim and then a steep descent by another construction road into the canyon at the downstream portals. Downgrade the route passes huge dumps where suitable areas have been found to place tunnel rock in accordance with terms of the contract. It continues past the mouth of a 500-ft. trucking tunnel driven to permit opening up an additional area in a side canyon for the disposal of rock, down past the intake of Boulder City waterworks, with its preliminary settling basin, to the portals on the Nevada side.

Tunnel Heading—A quick trip to the heading of tunnel No. 1, which is the last of the four downstream headings still operating on bench enlargement, reveals working conditions. (This heading was holed through April 2.) The floor is rather muddy with silt from the flood, although under ordinary conditions the tunnels are perfectly dry. Up at the face the truck-mounted drilling jumbo swarms with a crew of 45 men working under floodlights operating 30 drills hammering away on holes for a 17½-ft. round. This face is 30 ft. high, and at the top can be seen the outline of the 12x12-ft. pioneer heading, from which fresh air is pouring from a blower located near the adit to the pioneer tunnels. This fresh air travels down over the face of the bench and even during mucking, when the trucks are in operation at the face, no conditions having arisen to prove unsatisfactory as far as air supply is concerned. Farther back in the tunnel a crew is servicing the big electric shovel for its next round, when it will move 1,200 cu.yd. of rock in about a seven-hour mucking period.

Back to Town—Out of the tunnel and back up the road a fleet of covered lorries is passed that are bringing the swing shift down to work. Across the river can be seen the steep trucking road and the tunnel waste-disposal dumps extending high up on the canyon walls. The road doubles back upstream into extremely rough country to provide access to the Arizona spillway location where open-cut excavation will be started as soon as the road is completed. A short side trip to the location of the Nevada spillway shows excavation well under way, removing the 300,000 cu.yd. of rock in this open cut.

Back along the road to Boulder City the shadows deepen on the desert mountains after a full day that has afforded only the briefest glimpse of some of the main features of this gigantic construction project. Over the rise and down into Boulder City the trip is completed just as the lights begin to appear. The return is well timed for the dinner call at the big mess hall. This particular meal of the ten served during each 24 hours finds a hungry crowd of about 600, which is sufficient to occupy the mess hall. The evidence is plain that a fine meal is well enjoyed.

Outside, the lights are bright in the big recreation hall, where hundreds are relaxing over cards and pool tables. Lights are also to be seen at the windows in both contractor's and government office buildings, where those responsible for planning, execution and supervision are still at work. Back along the highway to Las Vegas the multitude of details of all that has been seen during the day begin to fade into a few general impressions—a construction project of unprecedented size and interest, speed and coordination of execution in keeping with the immensity of the work; progress during twelve months, regardless of a torrid summer and slowly developing facilities, which reflects the highest credit on all connected with planning and carrying on the work; personnel from top to bottom of the highest type now molded into a construction unit that will carry forward the develpment with increasing acceleration. There is no need to enumerate the long list of names of those supervising and directing the work, as they are well known to all.

ENGINEERING NEWS-RECORD ARTICLES ON HOOVER DAM

Economic development	Feb. 6, 1930
Engineering plans	Feb., 6, 1930
Design and structures	Dec. 25, 1930
Preliminary activities	May 28, 1931
Power-line construction	June 25, 1931
Building Boulder City	Nov. 26, 1931
Six months' progress	Dec. 10, 1931
Tests of model of dam	April 7, 1932
Concrete-batching plant	April 14, 1932
A year's progress	April 21, 1932

Articles Scheduled

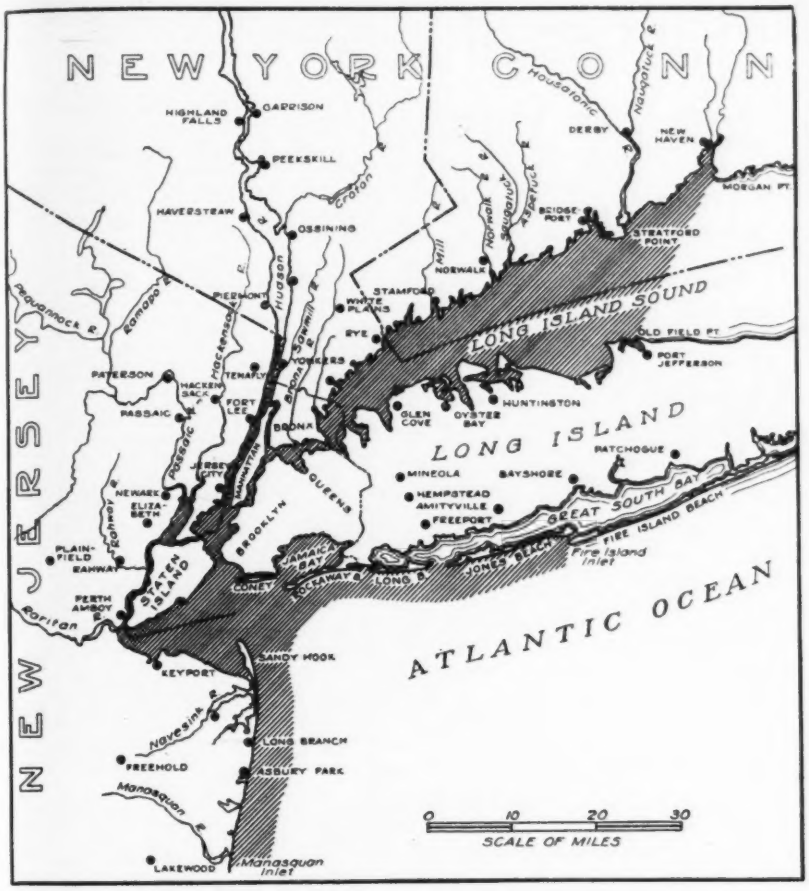
Tunnel excavation
Aggregate grading plant
Boulder City water supply

Tri-State Compact Recommended for Control of Pollution at New York

Reduction of pollution in the harbors and channels of the New York port district and at the near-by beaches of New York, New Jersey and Connecticut would be controlled by commissioners appointed by the three states

IDENTICAL BILLS for the creation of an interstate sanitation district and for the establishment of an interstate sanitation commission for the control of future pollution and the abatement of existing pollution in the tidal and coastal waters in and adjoining the New York Metropolitan District were presented to the New York and New Jersey legislatures for action this year, and similar bills will be presented to the Connecticut legislature at its next session, which will be in 1933. The bills presented in the New York State legislature were passed and have been signed by the governor and will become effective upon the approval of the bill presented in New Jersey. The bills are so worded that the interstate compact will become effective on approval by the states of New York and New Jersey in so far as it affects waters within those two states and is within the power of the two states to act without consent of Congress. If Connecticut also desires to become party to the compact, its approval will make possible the extension of the treaty area to include that part of the Connecticut shore area contributing a large amount of pollution to Long Island Sound.

The bills before the New York and New Jersey legislatures are the result of a survey made by a commission appointed some time ago to study pollution of the harbor and coastal waters of the district and to recommend to the three states what action should be taken. The actual study of the available records for determining the extent of pollution, the determination of the area to be included under an interstate compact, and the drafting of the compact were placed in the hands of a research and engineering committee consisting of Frank S. Tainter, chairman, a member of the firm of Parsons, Klapp, Brinckerhoff & Douglas, consulting engineers, New



Tidal waters of three states are included in the area covered by the proposed pollution-control compact. Waters to be placed under control of the commission are shown shaded in this map reproduced from the engineers' report.

York, and also a member of the New Jersey State Department of Health; Thomas Parran, Jr., commissioner and Charles A. Holmquist, director of the division of sanitation, New York State Department of Health; James A. Newlands, president of the Henry Souther Engineering Co., of Hartford, Conn., and a member of the advisory council of the Connecticut State Department of Health; William Schroeder, chairman of the New York City Sanitation Commission; and H. A. Foster, engineer, New York.

The area considered by this committee to be included under the provisions of the compact is shown in the accompanying map, which is reproduced from the committee's final report. The jurisdiction of the proposed sanitation commission in that area will include "all the coastal, estuarial and tidal water within or covering portions of the signatory states and those portions of all towns, cities, boroughs and villages that border upon and the natural drainage from which is tributary to such tidal water, together with all areas in the signatory states, the artificial drainage, sewage or sewage effluents which now discharge or may hereafter discharge through artificial outlets to such tidal waters."

The proposed compact calls for the appointment of five commissioners by each of the two states, or the three states if Connecticut joins with New Jersey and New York. The commissioners so appointed are to constitute the sanitation commission, which is empowered to determine into which of two classes all waters under its jurisdiction are to be put, the two general classifications being prescribed in the compact. It also is empowered to issue orders requiring such treatment of sewage and industrial waste as it deems necessary to obtain or maintain the purity required by it, and to stop contamination of the waters under its jurisdiction by injunction proceedings. The commission will have no power to undertake the construction of sewage-disposal plants or other work to put its orders into effect. Responsibility for making its orders effective is assumed by the states, jurisdiction to be exercised through existing channels such as the state departments of health.

The proposed compact divides the waters under the jurisdiction of the commissioners into two classes: (1) class A, in which the designated water areas are expected to be used primarily for recreational purposes, shellfish culture and the development of live fish; (2) class B, in which the designated water areas are not expected to be used primarily for recreational purposes, shellfish culture or the development of fish life. The signatory states agree that no sewage or other polluted matter shall be discharged or permitted to flow into the tidal waters of the district except under the following conditions:

1. All sewage discharged or permitted to flow into class A waters of the district shall first have been so treated as:
   (a) To remove all floating solids and at least 60 per cent of the suspended solids, and
   (b) To effect a reduction of organisms of the B. coli group (intestinal bacilli) so that the probable number of such organisms shall not exceed one per cubic centimeter in more than 50 per cent of the samples of sewage effluent tested by the presumtive method; provided, however, that in the case of discharge into waters used primarily for bathing this bacterial standard need not be required except during the bathing season; and
   (c) To effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the district and in the general vicinity of the point of discharge of the sewage in those waters, at a depth of about 5 ft. below the surface, of not less than 50 per cent saturation during any week of the year.

2. All sewage discharged or permitted to flow into class "B" waters of the district shall first have been so treated as:
   (a) To remove all floating solids and at least 10 per cent of the suspended solids, or such additional percentage as may by reason of local conditions be necessary to avoid the formation of sludge deposits in the class B waters of the district, and
   (b) To effect a reduction in the oxygen demand of the sewage effluent sufficient to maintain an average dissolved oxygen content in the tidal waters of the district and in the general vicinity of the point of discharge of the sewage into those waters, at a depth of about 5 ft. below the surface, of not less than 30 per cent saturation during any week of the year.

3. If the commission shall determine, after investigation, that owing to topography or other local conditions, either natural or artificial, in a part of any municipality discharging sewage into the tidal waters of the district, it would be impossible or impracticable to meet the above requirements in either class A or B waters with respect to suspended solids or oxygen demand, a modification of these requirements may be permitted; provided, however, that the sewage discharged from adjoining areas in such municipality shall be given the additional treatment necessary to effect an average reduction of suspended solids and oxygen demand of all the sewage discharged from such contiguous areas (including the portion of the area of the municipality where the requirements have been modified) equal to the requirements stated above.

In addition to agreeing to place control over the waters actually within the compact area under the jurisdiction of the treaty commissioners, the signatory states also agree that water flowing into the compact area waters in tributary streams shall be maintained up to the standards laid down by the commission for the waters into which such streams discharge.

The commissioners are instructed under the proposed treaty to prepare a plan of the most practicable and economical method of securing conformity with its standards, having in view the future growth and development of the district, and to submit it to the legislatures and governors of the signatory states.

Economy in Wider Use of Protective Coatings on Pipes

Laying bare pipe in oil and gas lines and postponing application of protective coating until corrosion develops found to be uneconomical in most instances

By Wm. Thompson Smith
Engineer, Ford, Bacon & Davis, Inc., New York, N. Y.

GREAT EXPANSION of pipe-line construction for the transmission of gas and oil in recent years brought with it an increase in the problem of protecting lines against corrosion. The first cost of coating an entire line amounts to such a considerable item that no coating was used in many instances, and in others protective coatings were used only where corrosion could most logically be expected. Out of this latter plan grew a system of soil studies to determine by chemical analysis where protection against corrosion should be provided along the route of a projected pipe line. Little attention, however, has been given as yet to all the economic considerations entering into an advance determination of how much protection should be provided as the result of the soil studies along a particular line. In the study presented herewith Mr. Smith endeavors to correlate these factors. —EDITORS.

QUESTIONS as to how and whether to protect pipe lines from corrosion arose simultaneously with the designing of the first underground metal pipe line. The answer to the question of how to protect such lines is dependent upon the applicability and accuracy of various theories concerning the causes and mechanism of corrosion. The answer to the question whether to protect depends purely on relative economies. Beyond the point of assurance that some merit, however small, is possessed by the particular protective process or material under consideration, the comparative worth of various forms of protection is beyond the scope of this question.

Varying conditions complicate the problem

An underground pipe line may be laid either bare or with some form of protection, which usually takes the form of a coating or shell of concrete, asphalt, coal tar or some similar material which experience has shown to be more resistant to the action of corrosive agents in the soil than is the pipe metal itself. Corrosion and deterioration of the pipe are thereby postponed. A bare line will inevitably corrode, but the rate of deterioration generally will not be uniform throughout the length of the line. It is by no means uncommon for certain relatively short sections to require reconditioning or even replacement within two to three years of the time of laying, although other sections may remain in good condition for ten, fifteen, or twenty years or longer. The term "hot spots" has been given to those sections of ground where soil corrosion is found to be markedly severe.

Cost of coating entire line when laid difficult to justify

The application of pipe-line coatings involves material and labor costs which, though small compared with the total cost of the line, are nevertheless substantial. Except at hot spots these costs are somewhat difficult to justify. Certainly in a generally non-corrosive area (if such a soil character can be conclusively proved) coating should be used only at locations known or suspected to be corrosive.

Within the past five years much attention has been given to and valuable results have been obtained from the development of dependable and reliable means for the predetermination of soil corrosivity. By the use of such methods, which are as yet admittedly not absolutely exact, it is possible to allocate limited appropriations for pipe-line protection and coating to the sections where it is most necessary. Many designers and operators, on the other hand, prefer to lay pipe lines without protection of any sort and await the development of corrosion and leaks as a definite and infallible indication of the locations where protection is required. Those sections of line are then uncovered, raised, thoroughly cleaned and relaid, at costs which are high when compared with initial construction costs, with sublime confidence in the belief that savings resulting from the omission of coating where it was not urgently necessary and from decreased interest charges by belated expenditures will more than balance the cost of the protection finally applied.

Such a policy with respect to protection has been advocated with increasing frequency and emphasized in current magazine articles dealing with pipe-line subjects and in papers presented before interested associations.

In far more cases than is commonly suspected this policy is wrong and the expected saving is non-existent, if indeed there is not a loss. The composite effect of the major factors bearing on the economics of this procedure is subject to close determination based upon reasonable assumptions, though this apparently is seldom done. Then, too, there are a host of other considerations the effects of which, though important, are not capable of accurate estimation in advance. Among these are:

1. Since hot spots are to be located only by leaks there may be an interruption of service not only during the time required for repairs but also during the time after the leak is discovered until repair materials and crew can get to the point of trouble.
2. Oil or gas may be lost by leakage, in amounts dependent upon both the size of the leak and the time interval between its occurrence and its repair or the interruption of service.
3. The discovery of hot spots will be irregular, both as to time and as to location. This does not permit the definite scheduling of work or expenditures.
4. The operator can never be sure that all hot spots along his line have already been discovered.
5. Before corrosion has proceeded to an extent which will show the existence of a hot spot by causing a leak there will be in most cases a general weakening of the pipe wall in that immediate vicinity.
6. Corrosion may be so extensive before discovery and repairs as to require pipe replacement.
7. When the policy of waiting for hot spots to develop has been adopted, it is necessary to keep a larger and more skilled repair crew on duty or subject to call, or to recruit one of less experienced labor, which involves increased costs and slow work until organized.
8. Hot spots, on account of their very nature, are more apt to be found in relatively inaccessible locations.
9. There is always uncertainty as to the exact length of line involved at any one location.
10. With ordinary cleaning it is difficult to get a first-class application of any protective coating on corroded pipe. Properly thorough cleaning in such cases is expensive.
11. Working on separated and relatively short lengths of line increases costs per foot.
12. In repairing leaks and doing reconditioning work at hot spots, makeshift and therefore less economical equipment is often used, because equipment best suited for the particular job is not available promptly enough, if at all.
13. The policy of waiting for hot spots to develop before coating results in higher depreciation and fixed charges on account of the excess emergency repair equipment which must be kept available.
14. Particularly in the case of pipe lines through cultivated areas, as to a lesser extent elsewhere, repair work at a hot spot may involve large claims against the operating company, as for instance for damage done to growing crops.
15. If the operator prefers to wait for hot spots to develop rather than to coat the entire line during construction, only a small fraction of the total length of line can be protected for equal total expenditure.
16. Practical considerations usually lead to the reconditioning of a minimum length of from 150 to 200 ft. at any one point regardless of the exact extent of the proved hot spot. A summary of total length of hot spots alone, as a measure of the amount of reconditioning to be expected, is frequently highly deceptive.

Reconditioning unprotected pipe offsets much of original saving

Generally speaking, only surprisingly small percentages of the total length of a bare line can be reconditioned before the total costs will equal or exceed the cost that would have been entailed by the application of complete protection during the original construction. Unofficial tentative estimates of the U. S. Bureau of Standards place the total mileage of pipe lines in the United States at 45,000 miles, valued at $5,680,000,000. This is an average value of $12,500 per mile. Estimating the cost of protection, applied during original construction, at 4 per cent, the average cost of protecting these lines would have been $500 per mile, or 9.5c. per foot. C. R. Weidner, at a meeting

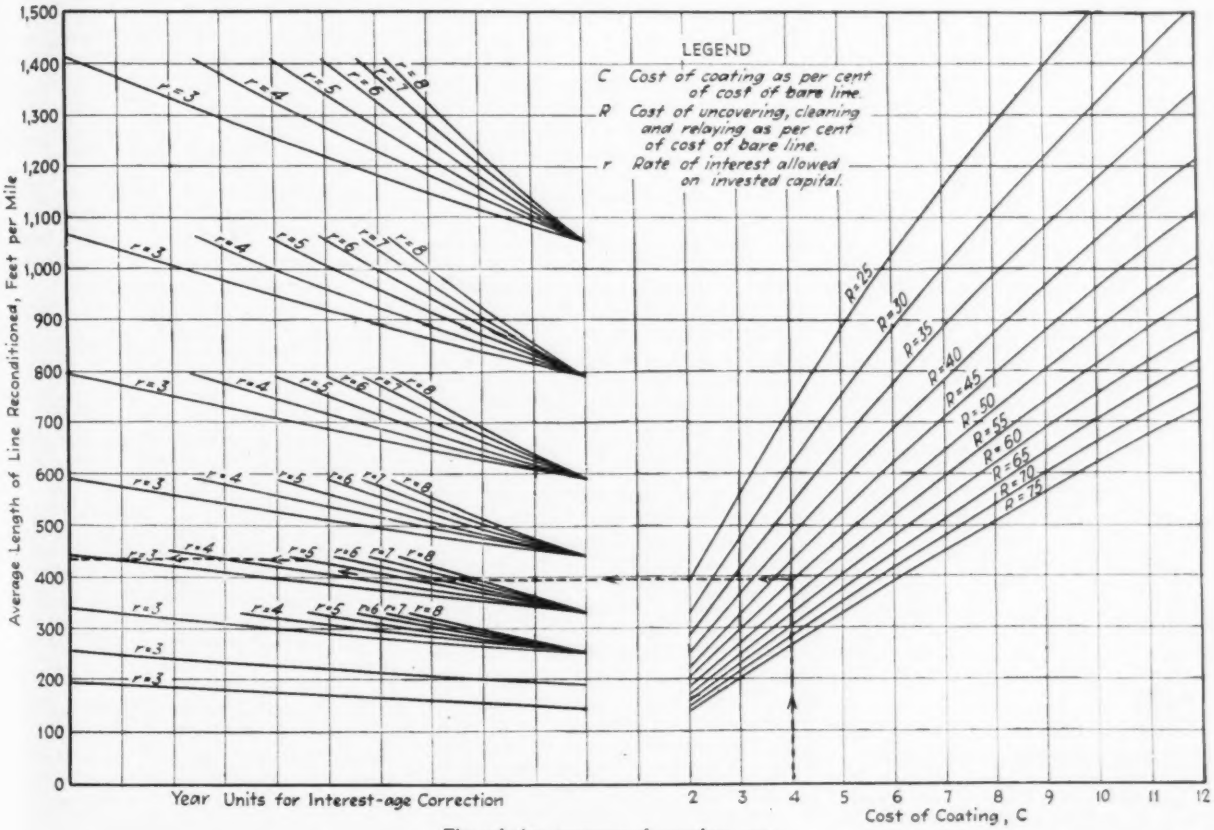
of the American Petroleum Institute, has given cost data for 31 reconditioning jobs totaling 123.45 miles of 8-in. pipe which show an average of 88c. per foot, or approximately $4,650 per mile. At this rate, neglecting interest charges, only about 570 ft. of line could be reconditioned before the total cost would exceed the cost of complete initial coating. Although equal amounts would then have been expended, more than 4,700 ft. per mile, or nearly 90 per cent of the reconditioned line, would still remain without protection. Furthermore, it is only fair to note that Mr. Weidner's costs do not consider or allow for loss of revenue during repairs, loss of gas or oil, interruption of service with accompanying loss of good will and danger to franchises, use of inexperienced labor or use of makeshift equipment.

Factors affecting coating costs

Several factors affect the relative economy of complete coating during original construction as compared with the construction of a bare line with the intention of reconditioning sections where corrosion occurs. These factors are:

1. Material and labor costs of pipe protection expressed as a per cent of the cost of an equal length of bare pipe line.
2. Reconditioning cost, exclusive of material and labor costs for coating, expressed as a per cent of the cost of an equal length of bare pipe line. This cost must include all material and labor charges incident to uncovering the line, raising, cleaning and relaying, and also adequate allowances for the probable loss of gas or oil, interruption of service, loss of good will, use of relatively inexperienced labor, pipe replacements, inaccessibility of point of failure, abnormal cleaning costs, use of makeshift equipment, crop and other damages, etc.
3. Rate of interest, compounded annually, to be allowed on invested capital.
4. Average age of line at time of reconditioning.

Necessarily these factors may be expected to vary widely according to special conditions prevailing in particular instances. However, with these values all known or subject to reasonable assumption, it is possible to calculate definitely the average number of feet per mile which can be reconditioned before the total costs, including interest charges, will equal or exceed the cost of coating all of the line during initial construction. This figure is independent of the eventual total serviceable life of the line.



The relative economy of complete coating at time of construction as compared with reconditioning is subject to graphical determination.

Economies determined by chart

The results of such calculations may be presented as in the accompanying chart for the quick solution of similar problems. The chart is drawn to cover the extreme range of variations to be expected in the four factors considered. It may be used for any interest rate between 3 and 8 per cent annually. It covers a range in cost of coating of from 2 to 12 per cent of the cost of laying an unprotected line. It allows a variation in reconditioning cost of from 25 to 75 per cent of the initial construction cost of a bare line. It will cover any degree of corrosiveness at hot spots, as indicated by the average age of the bare line at the time when the resulting deterioration of the pipe makes reconditioning desirable.

While the range of variation afforded is expected to cover any probable set of conditions, it is interesting to consider the more limited field in which most cases will lie. For natural gas or oil transmission lines, on account of the distances usually involved and the resulting opportunity to develop a more or less skilled organization through experience, the cost of coating is fairly low, and for an enamel application may be expected to be between 3 and 5 per cent of the total cost of a bare line, including labor, material and all overhead and financing charges. The cost of reconditioning such lines varies widely, but the bulk of the cases probably involve a cost of from 40 to 60 per cent of the cost of a bare line. On the other hand, in natural or manufactured gas distribution systems, the cost of coating is usually slightly higher and will probably range from 4 to 6 per cent. Because of the difficulty of working in congested areas and the complications due to the existence of paving, trees, conflicting underground structures, etc., the cost of recondition-

ing distribution systems is high, ranging upward from 70 per cent in the majority of cases.

Coating advisable if probable reconditioning exceeds 16 per cent

For transmission or distribution systems 5 per cent may be used as a normal interest rate. Fairly severe though not uncommon corrosive conditions will necessitate reconditioning in the bad spots usually in from one to three years, or an average of two years. Fairly mild corrosion will necessitate reconditioning in part in from six to ten years, or an average of eight years. It should not be overlooked, however, that in the latter case as the length of time increases before corrosion makes itself apparent by leaks the spread of years during which the majority of the hot spots will develop also increases. Furthermore, because the line as a whole is older there can be correspondingly less assurance that trouble will not soon develop in those portions of the line that have not been reconditioned.

Considering the above-mentioned ranges, the percentages of the total line which may be reconditioned in transmission systems may ordinarily be expected to be between 5 per cent where hot spots are severely corrosive and 16 per cent where a combination of favorable conditions exists including high coating costs, low reconditioning cost and rather mild hot spots. In the case of distribution systems the range is somewhat narrower, being from approximately 5 to about 12 per cent. If there exists reason to believe that any larger part of a line than is represented by these percentages will require reconditioning, it will be found cheaper to coat the entire line during the initial construction period than to rely on later reconditioning.

Corrosion records misleading as basis for reconditioning estimates

The percentage of line to be reconditioned is possibly misleading to those whose records show the exact length of line where corrosion has been found or is to be expected. In reconditioning work the application of coating is almost never confined strictly to the length of line which is corroded. Practical considerations usually place a minimum limit on the length which can be economically treated, and a desire for safety, usually coupled with a degree of uncertainty as to the exact boundaries of the hot spot, dictates the application of some additional footage. Coating is commonly applied to from two to five times the length of the hot spot itself. With this in mind, it follows logically that if hot spots themselves along transmission lines may constitute more than from 1 to 3 per cent of the total length, or from 1 to 2½ per cent in the case of distribution lines, money will be saved by providing for complete protection when the line is originally laid.

The accompanying chart consists of a group of curves at the right-hand side, of which each curve shows the variation at some constant cost of reconditioning R, as the cost of coating C varies. On the left-hand side are several sets of curves by which the necessary correction can be made for the rate of interest to be allowed and for the degree of severity of the hot spots as indicated by the average age of the line at the time of reconditioning.

Graphic solution of question of reconditioning or initial coating

For illustration, assume that an engineer must decide with respect to a particular proposed line whether it will ultimately be cheaper to coat the line 100 per cent or to lay the line bare and recondition it at hot spots as leaks develop. In the particular instance the engineer estimates that it would cost half as much to recondition a mile of line as it would cost originally to lay the same length bare, but he realizes that possibly only a short total length of line will need to be reconditioned. On the other hand, he estimates that the cost of coating would amount to 4 per cent of the cost of a bare line. He has reason to believe that certain sections of the line, if laid bare, would require reconditioning in from one to three years, or in an average of two years. He must allow for interest charges at the rate of 5 per cent compounded annually.

A dotted line is shown on the chart for the solution of this problem. Starting at 4 per cent on the C scale, draw a line vertically upward to intersect the curve for a reconditioning cost, R, of 50 per cent. From this intersection, draw a line horizontally to the left until it meets a 5 per cent interest-age correction curve. Continue, to the left, along this curve (and, if necessary, successively along one or more of the 5 per cent interest-age correction curves above it) for a total number of horizontal spaces equal to the number of years assumed as the average age of the line at the time of reconditioning. Then draw a line horizontally to the left-hand marginal scale, reading the result as 435 ft. per mile. The designer now knows that if there is reason to expect that more than 435 ft. per mile of bare line must eventually be reconditioned it will prove cheaper in the end to provide initially for complete coating at the time of original construction.

Small effect of soil conditions on amount of line to be reconditioned

If the soil conditions along this assumed pipe line had been much less corrosive, the engineer, instead of expecting reconditioning to be required in an average of two years, might have expected trouble from soil corrosion to be developed in from six to ten years, or in an average of eight years. Other conditions remaining the same, the first part of the solution by the chart would not be changed. When making the interest-age correction, however, instead of continuing along the curve for two spaces, continue for eight horizontal spaces before reading the result by the left-hand marginal scale as 580 ft. per mile.

It is readily seen that, in comparing a relatively non-corrosive soil with a rather actively corrosive soil, the resulting increase in length per mile which could be reconditioned is only 34 per cent. Figured as per cent of total length of line, the small magnitude of the difference resulting from degree of corrosivity is even more striking. The amount of line which could be reconditioned before the total cost would exceed the cost of 100 per cent original coating is increased only from 8.2 to 11 per cent.

In estimating the length of line which will probably be reconditioned, the engineer will naturally have in mind not just the length of line at each hot spot where corrosion has been found to be severe. As a matter of convenience as well as good practice at least 50 to 100 ft. would be reconditioned on either side of the section where serious corrosion had occurred. In any event, seldom less than 200 ft. would be reconditioned at any one location, even though bad corrosion and pitting had occurred for a distance of only 25 ft. If there were, on an average, two such sections per mile, the length of line reconditioned would amount in total to about the 435 ft. per mile found in the first example. This amount of line would be reconditioned, although the severely corroded length is only 50 ft., or less than 1 per cent. In other words, the result obtained by use of the chart represents the total length of line which would be reconditioned, including not only the hot spots themselves but also the additional lengths coated for reasons of convenience as well as justifiable precaution.

In general, the length of line actually reconditioned is several times the total actual length of severely corroded sections, except where hot spots are so frequent as to make it obviously preferable to apply 100 per cent coating initially. Under most conditions the probability of hot spots totaling even as little as 1 to 2 per cent of the total length of an underground pipe line should properly lead the designing engineer to specify complete coating as a part of the original construction.

The best warranted method of saving in protection costs is not by the dubious wisdom of waiting for hot spots to develop before using any coating but by coating all known or suspected areas of corrosion and omitting coating in non-corrosive areas as determined by a thorough and reliable soil-corrosion survey.

Appropriation Slash Will Interrupt Study of Water Resources

Government will not match state cooperative funds—Extensive curtailment of stream gagings, flood and runoff measurement will be necessary—Power, water supply, sanitation and flood protection are dependent on continuous records

A SLASH in appropriations, regarded now as inevitable, will seriously interrupt the Geological Survey's systematic study of water resources. The continuity and comparability of data collected in investigations of groundwater, streamflow and floods throughout the country are essential features of work that must be curtailed because of a cut from $719,500 to $600,000 in the budget for the ensuing fiscal year. The Senate appropriations committee sought to fix the total at $700,000 but was forced to revert to the reduction previously voted by the House. The Senate committee refused to cut any deeper although it was under instructions to curtail any or all items to the extent necessary to reduce by 10 per cent the appropriation made by the House for the department of interior as a whole.

Additional loss will result from the inability to take up all available state cooperative funds, although the Senate committee succeeded in protecting the greater part of the money available for cooperative work. The House bill would have permitted the Survey to use for cooperative work only $400,000 of the amount appropriated. Realizing that for every dollar the cooperative allotment is cut, the Survey will lose $2, the Senate committee raised the limitation on cooperative work to $450,000, after first recommending $518,000 to match the amount made available by the states on the assumption that federal cooperation would be forthcoming on the usual 50-50 basis. In view of the reduction in the total appropriation, the earmarking of a larger sum that can be spent only in cooperative work would have had the effect of crippling some work that necessarily must be carried on without state cooperation.

The House committee sought to justify the reduction to $400,000 as due to the material decrease in requests from the states. The fact is that the great drought, officially declared at an end only a few weeks ago, created such interest and anxiety concerning available surface and groundwater supplies in all sections of the country that funds offered by the states are the largest in history, exceeding the total of $552,000 carried for this purpose in the federal appropriation for the current year. A further argument for fulfilling the assurance of federal cooperation so far as possible is that, having contributed generously to the work for this year and next, the states may be forced by depletion of their revenues to curtail appropriations for the fiscal years 1934 and 1935.

Expenditures for water studies constitute a permanent investment that is steadily increasing in value. But this value is largely destroyed if the records are interrupted. All parts of the country will prospectively be affected. When the Geological Survey first undertook its work, 45 years ago, data on water resources were of interest principally to the arid and semi-arid regions of the West; except in such regions, the water supply did not present a difficult problem in a sparsely settled country, for water was available in sufficient quantities. But as population doubled and industry expanded, the definite limit on the water resources of any region made itself felt, and there came an ever-increasing demand for reliable information on the available supply.

Continuity is basic to the value of water data, experience shows. It is far more important since the great spreading of demands for city supply, for power (both hydro and steam) and for industrial processing. Both quantity and distribution must be known thoroughly to permit supplies to be utilized to maximum capacity and to control the priorities of different uses. The interruption of many records due to reduction of funds this year will therefore have far-reaching effects.

Few communities have not had difficult water problems to meet and overcome. Questions relating to the supply available are arising in connection with valuations of public utilities, and the answers affect all who use their output. States have set up water codes to govern the use of water within their boundaries. Numerous problems have arisen in connection with the use of interstate water, and regulation has been enforced either by compact or court decrees. The data on which such questions are decided have usually been supplied by the Geological Survey, as few private records exist.

Because of the wide variations in occurrence of water from year to year and month to month, data must extend over a sufficient period to indicate seasonal and annual variations. Such data can only be gathered years in advance of their utilization. A case in point will illustrate their value. The special master in the recent Delaware River diversion case stated:

> There was a vast volume of evidence as to the effect of the proposed diversion. In determining this effect the parties necessarily resorted in the main to the same basic data. The most reliable information obtainable consisted of the streamflow records of the gaging stations of the U. S. Geological Survey and some state records. . . . The streamflow records of the Delaware River do not exist for any long period of time. It would have been much more satisfactory if complete streamflow records had been available for a number of points on the Delaware River for a period, say, of 50 years.

Thus, in order to anticipate the solution of such questions, records must be maintained now. With expansion of metropolitan areas and increase of flood hazards, the construction of reservoirs and other works will reach a scale scarcely visualized today.

Hydraulic engineers point out that not only must the work be continuous but the data collected throughout the country must be of comparable accuracy. Experience has demonstrated that both requirements can best be accomplished by coordinating the investigations of federal, state and local agencies, with which private agencies also may cooperate. The cost of obtaining reliable information available when the need for it arises is insignificant in comparison to the direct and indirect losses due to delays in development, overdevelopment and wasteful use.

Development of additional supplies, shown to be necessary by the experience suffered in the 1930-31 drought, has brought streamflow records into wide use. Hundreds of stream-gaging stations were required in connection with the Army Engineer Corps' survey of all navigable streams upon which power developments appear to be feasible. This program will be completed this year, but fortunately, in the light of the need for continued data on streamflow at many potential sites, restrictions imposed by Congress last year, which threatened abandonment of a large number of gages, have been removed.

As 50 per cent of the country's population still depends upon wells for its water supply, the need for continuing groundwater investigations is fully as great as those in connection with surface-water resources. Interest in groundwater supplies, always of vital concern in the West, has been intensified in the East by the drought. The Survey now is engaged in a study of the groundwater supply on Long Island, as a result of New York City's proposal to draw 94,000,000 gal. more from Nassau County wells that now supply the city with 100,000,000 gal. Another intensive investigation is under way in Houston, where the increasing demands of industry and expansion of rice cultivation are taxing the present supply. An investigation to determine groundwater conditions in the East Texas oil field, with particular reference to the effect of well-drilling and operation

upon the mineral character and sanitary condition of the groundwater, was recently completed.

In addition to the strictly utilitarian use of data on water resources, there is a large demand for the records for purely scientific studies, principally in connection with problems encountered in meteorology, geology and the character and distribution of plant life. For this purpose systematic and continuous records are desirable, for comparison with the data on these other physical phenomena. Curtailment to fit this year's reduced appropriations now threatens to affect all these operations. Details of the necessary cuts are now being studied by the Survey.

Design for Casing Pipe for Pipe Undercrossings

Calculation and tabulation of shell thicknesses based on Marston's conduit-load theory and the Boussinesq law of concentrated-load distribution

By M. G. Spangler
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THE PROGRESS of research in developing the theory of load stresses on conduits with earth supercharges has added largely to the confidence of the engineer in attacking special problems of design of earth-covered pipes. In the case considered in this issue unique features characterize the special problems. The type of construction is limited to oil and gas-line development, special hazards accompany conduit failure, and ordinary earth supercharge loads are increased by concentrated and impact rolling loads. The adaptation of research determinations to this combination of factors of the problem presents an interesting study. —EDITOR.

THE RAPID EXTENSION of pipe lines for distributing natural gas and oil has brought a number of new engineering problems. One upon which the engineers of pipe line companies and railways have failed to reach agreement is the structural design of steel casing used to surround the carrier pipe at crossings under railways. The Iowa Railway Commission has requested the Iowa engineering experiment station to assist in the preparation of specifications covering the design of such pipe for both railway and highway crossings. The results of this study may be of value, because the problem involves an interesting application of both Marston's conduit-load theory and the Boussinesq law of distribution of concentrated loads.

The casing pipes are usually 2 to 6 or 8 in. larger than the carrier pipes and are slipped over them at crossings to protect them from injury from the continued pounding of traffic loads in combination with the earth load. A major catastrophe might result if a break should occur in a pipe line at such a crossing, releasing large quantities of highly inflammable fluid on the right-of-way. The need for adequate strength of the casing pipe is at once apparent. Since the pipe lines must usually cross beneath existing structures, the most common practice is to bore a hole beneath the railway or highway and insert the casing pipe from one end. The diameter of the bored hole is limited to a maximum of 4 in. greater than the outside diameter of the casing pipe.

Marston's theory of loads on conduits in earth recognizes two distinct classes of conduits: (1) ditch conduits, which are installed in ditches excavated in relatively solid or passive materials, such as sewer pipes, water mains and drain tile; and (2) projecting conduits, which are installed with a portion of the conduit projecting above the solid passive material and then covered with comparatively loose and newly placed embankment material. Highway or railway culverts are common examples of this latter class of conduit.

Pipe-line casings, installed in a bored hole, do not readily fall into either of these classes when they are first constructed; the cohesion in the earth above the hole tends to support its own weight and the traffic above it for an unknown length of time. However, alternate wetting and drying and freezing and thawing, with the vibration and pounding of intermittent traffic loads will sooner or later destroy this cohesion completely and the prism of earth directly above the bored hole will move downward until it rests directly on the casing pipe. When this occurs, the loading condition will be very similar to that of a ditch conduit, since the cohesion will be broken down along roughly vertical planes tangent to the sides of the bored hole. It seems entirely logical, therefore, to calculate the earth load on casing pipes by means of Marston's ditch conduit load formula.

The effect of traffic loads on conduits in earth has been found, by experiment, to be in accord with the Boussinesq law of pressure distribution. The practical

Fig. 2—Loading diagram for two 15-ton trucks.

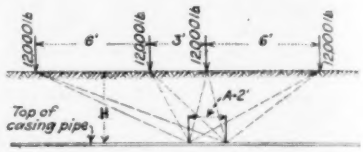


Fig. 3—Load variation with height of fill for Coopers E-70 loading.

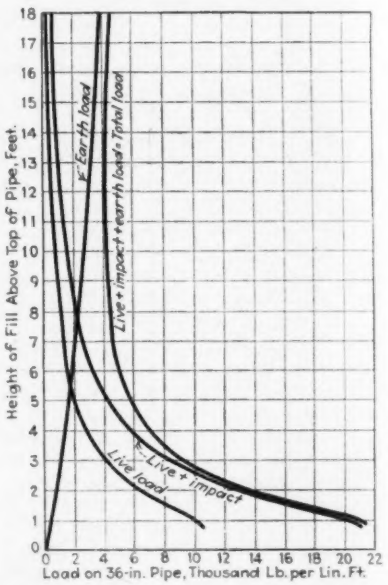
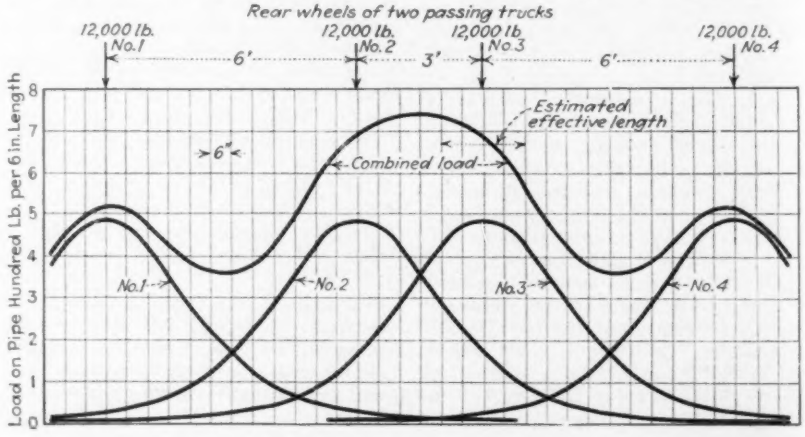

Height of Fill Above Top of Pipe, Feet
Earth load
Live + impact + earth load = Total load
Live + Impact
Live load
Load on 36-in. Pipe, Thousand Lb. per Lin. Ft.

Fig. 1—Combined load on 36-in. pipe due to four truck wheels with 4-ft. pipe cover.



application of this theory, however, to a longitudinally continuous conduit involves an assumption as to effective length, which is defined as the length of pipe over which the pressure produced on the pipe by a concentrated superimposed load at the surface may be assumed to be uniformly distributed in a longitudinal direction in order to produce the same calculated stress as the maximum stress that actually occurs directly under the load. In this work the effective length was estimated after drawing curves showing the longitudinal distribution of the total load on the pipe due to all wheel loads centered on the axis of the pipe, as shown by the sketch in Fig. 1.

An allowable unit stress of 20,000 lb. per sq.in. has been used in calculating the thickness of these steel-casing pipes, which may seem to be a rather high value. However, it is believed that this figure will give a factor of safety entirely in keeping with conservative practice and comparable with the factor of safety attained in ordinary steel structures when 16,000 or 18,000 lb. working unit stresses are used. This belief is based upon the fact that the flexibility of steel pipes will permit sufficient deflection under load to develop some passive-resistance pressure at the sides of the pipe, and such pressure will increase as the deflection increases. Since lateral pressure on the pipe is effective in reducing the stresses due to vertical load, it is apparent that the stress in such a structure will not increase as rapidly as the vertical load on it, and therefore the ratio of ultimate load to design load, or factor of safety, will be greater than the ratio of ultimate stress to design stress. The following design specifications have been devised to be used in pipe casing practice.

Load computation

The pipe-line casing shall be designed to support vertical loads due to the earth embankment through which it passes plus both static and impact live loads due to the superimposed traffic, such as highway trucks or railroad rolling stock.

Earth Loads—The earth load shall be calculated by Marston's formula for loads on pipes in ditches.

$W_e = C_d w B_d^2$ in which

$$C_d = \frac{1 - e^{-2k\mu \frac{H}{B_d}}}{2K\mu}$$

W_e = Earth load, in pounds per linear foot.

w = unit weight of earth = 110 lb. per cubic foot.

B_d = breadth of ditch = diameter of bored hole in which pipe is placed = diameter of pipe plus 4 in.

K = Ratio of lateral to vertical pressure of earth (Rankine's formula).

μ = Coefficient of internal friction of earth $K\mu$ shall be considered = 0.130.

H = vertical distance from roadway surface or base of rail to top of pipe. Minimum values established by the Iowa Railway Commission shall be 4 ft. for highways and 4½ ft. for railways.

e = base of natural logarithms = 2.71828.

THICKNESS OF CASING PIPES UNDER HIGHWAYS AND RAILWAYS

Size of Pipe, In.	Height of Fill, Feet	Highways: Heavy Traffic Calculated Thickness, Inches	Highways: Heavy Traffic Total* Thickness, Inches	Highways: Light Traffic Calculated Thickness, Inches	Highways: Light Traffic Total* Thickness, Inches	Railways: Heavy Traffic Calculated Thickness, Inches	Railways: Heavy Traffic Total* Thickness, Inches	Railways: Light Traffic Calculated Thickness, Inches	Railways: Light Traffic Total* Thickness, Inches
12	4.0	0.174	0.299	0.152	0.277	.....	.....	.....	.....
	4.5	.....	.....	.....	.....	0.228	0.353	0.198	0.323
	5.0	0.158	0.283	0.138	0.263	0.212	0.337	0.185	0.310
	7.0	0.140	0.265	0.125	0.250	0.177	0.307	0.158	0.283
	10.0	0.128	0.253	0.119	0.244	0.152	0.277	0.138	0.264
	15.0	0.121	0.246	0.116	0.241	0.134	0.259	0.126	0.251
18	4.0	0.259	0.384	0.227	0.352	.....	.....	.....	.....
	4.5	.....	.....	.....	.....	0.340	0.465	0.294	0.419
	5.0	0.236	0.361	0.206	0.331	0.316	0.441	0.276	0.401
	7.0	0.212	0.337	0.190	0.315	0.267	0.392	0.238	0.363
	10.0	0.197	0.322	0.183	0.308	0.232	0.357	0.213	0.338
	15.0	0.192	0.317	0.184	0.309	0.210	0.335	0.199	0.324
24	4.0	0.344	0.469	0.301	0.426	.....	.....	.....	.....
	4.5	.....	.....	.....	.....	0.451	0.576	0.391	0.516
	5.0	0.314	0.439	0.275	0.400	0.420	0.545	0.367	0.492
	7.0	0.284	0.409	0.255	0.380	0.356	0.481	0.318	0.443
	10.0	0.268	0.393	0.251	0.376	0.314	0.439	0.289	0.414
	15.0	0.265	0.390	0.256	0.381	0.289	0.414	0.276	0.401
30	4.0	0.424	0.549	0.372	0.497	.....	.....	.....	.....
	4.5	.....	.....	.....	.....	0.557	0.682	0.483	0.608
	5.0	0.391	0.516	0.342	0.467	0.523	0.648	0.455	0.580
	7.0	0.356	0.481	0.321	0.446	0.446	0.571	0.398	0.523
	10.0	0.340	0.465	0.317	0.442	0.396	0.521	0.365	0.490
	15.0	0.340	0.465	0.331	0.456	0.370	0.495	0.353	0.478
36	4.0	0.506	0.631	0.445	0.570	.....	.....	.....	.....
	4.5	.....	.....	.....	.....	0.663	0.788	0.575	0.700
	5.0	p.466	0.591	0.411	0.536	0.622	0.747	0.543	0.668
	7.0	0.429	0.554	0.385	0.510	0.534	0.659	0.478	0.603
	10.	0.411	0.536	0.385	0.510	0.475	0.600	0.440	0.565
	15.0	0.418	0.543	0.404	0.529	0.451	0.576	0.433	0.558

* Total thickness equals calculated thickness plus 0.125 in. added for corrosion and pitting.

Static Live Load—The load effect on the pipe due to the superimposed traffic loads shall be calculated by the Boussinesq formula for transmission and distribution of concentrated loads through earth.

$W_t = \frac{1}{A} C_t T$ in which

$$C_t = a \sum \frac{3}{2\pi} \times \frac{H^5}{H_s^5}$$

W_t = static superload effect on pipe, in pounds per linear foot.

T = concentrated superload, in pounds.

Heavy-traffic highways: two passing 15-ton trucks having 12,000 lb. on each rear wheel, spaced as shown in the accompanying diagram (Fig. 2).

Light-traffic highways: one 15-ton truck.

Heavy-traffic railways: two engine drive wheels, Cooper's E-70. Light-traffic railways: Cooper's E-50.

A = the "effective length," which shall be 2 ft. for heavy-traffic highways, and 3 ft. for light-traffic highways and both heavy- and light-traffic railways.

The procedure for determining Ct shall be to divide a horizontal plane tangent to the top of the pipe of length A and width Bc (diameter of pipe) into a number of small equal rectangles not exceeding 6 in. on a side. Then calculate a load sub-coefficient for each of these rectangles by the formula:

Sub-coefficient $= a \frac{3}{2\pi} \times \frac{H^5}{H_s^5}$ in which

a = area of small rectangle, in square feet.

H = the vertical height from the top of the pipe to the surface of the embankment, in feet.

H_s = the slant height from the center of each small area, a, to the point on the surface of the embankment at which the concentrated load is applied, in feet.

The summation of all these sub-coefficients gives the value of C_t.

Impact Load—The impact live-load effect shall be considered to be equal to 100 per cent of the static live-load effect.

Supporting strength of pipes

The supporting strength of the steel-casing pipe shall be such that the combined earth load, static and impact live loads will not produce stresses in the pipe wall to exceed 20,000 lb. per sq.in. in tension or compression.

Load Distribution—For purposes of stress calculation the vertical load and the reaction on the bedding of the pipe shall be considered to be uniformly distributed over the top 90 deg. and the bottom 90 deg. of the pipe ring, respectively.

Lateral Support—When lateral earth pressure is assumed to act effectively on the pipe, the magnitude of such pressure shall not exceed 50 per cent of the vertical earth load and shall be considered to be uniformly distributed over the side 90 deg. segments of the pipe.

Stress Formulas—The bending moment at the top and bottom of the pipe may be calculated from the formula

$M = Wr\,(0.169 - 0.154q)$ in which

M = bending moment at top or bottom of pipe,

W = total vertical load on pipe,

r = mean radius of pipe,

q = ratio of *total* lateral pressure to *total* vertical earth and traffic loads.

Corrosion, Scaling and Pitting—To compensate for the probable corrosion, scaling and pitting of the pipe in service, ⅛ in. shall be added to the thickness of steel-pipe casing as determined by stress analysis.

Industrial Railway Equipment for Levee Building

Recent work on the Mississippi River has created a combination of dragline excavator and industrial railway equipment specifically adapted to embankment construction

By J. C. French
Bucyrus-Erie Co., South Milwaukee, Wis.

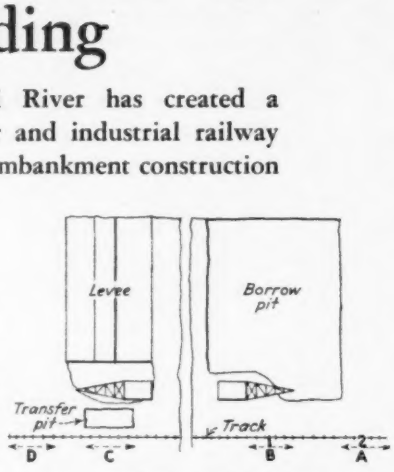
WHEN the new Mississippi River levee sections, with their large yardage and steep grades, were introduced in 1928, the need for revised methods of construction was immediately apparent to contractors and equipment manufacturers. Any method in which wagon haulage was a factor was seen to be at a disadvantage. Large crawler wagons and tractors were found to serve admirably in some cases; but when long hauls from the borrowpits were required, even this modern equipment was not always efficient. One result was the use of industrial railway equipment in combination with draglines and the development of a special technique in handling the earth from the borrowpit to the cars and from the cars to a transfer pit from which the levee dragline was fed. Applicable only to a particular set of conditions, this method, which is described in the following, has nevertheless proved its worth and is a distinct contribution to the levee-building art. —EDITOR.

THE CONSIDERABLE use of industrial railway haulage for standard levee construction on the lower Mississippi River is a development of the few years since the present flood-control project was inaugurated. Its previous use had been occasional or to meet construction conditions other than the normal operation of throwing up an embankment from an adjacent riverside borrowpit. As developed for standard levee construction, railway haulage is still in the process of experimentation to insure better coordination of procedure. Incidentally, railway haulage is not to be conceived as intended to compete with direct dragline or tower-excavator levee building where local conditions favor this equipment; it is designed to meet the unusual or adverse conditions of extremely long haul, bad weather, wet ground and unusual borrowpit locations that tend to make the other equipment impracticable.

Development of the system

Railway haulage as a designed system for levee building was first introduced on the river in 1928. It was called the Shea system after its inventor, Arthur J. Shea, president, Canal Construction Co., Memphis, Tenn. It was designed to overcome the shortcomings of the old wagon-haulage methods in meeting the new levee sections and grades. Briefly, it was a combination of dragline-excavator and industrial-railway equipment embodying a definite earth-transfer pit. The transfer-pit element characterized the system.

The first application consisted of a dragline excavator at the borrowpit and another at the transfer pit at the levee and of a 3-ft.-gage single track without a switch between the pits. An accompanying chart indicates the arrangement diagrammatically. Two trains of four or five cars operated on the track. Train 1 was loaded at *B* with train 2 (empty) standing at *A*. When loaded, train 1 was hauled to the transfer pit *C*, and train 2 pulled up to *B* to be loaded. When train 1 had unloaded into the transfer pit at *C* it was pulled ahead empty to *D*. Then train 2 (loaded) moved from *B* to *C* and discharged its load into the transfer pit. When train 2 had unloaded both trains were run back to their original positions at *A* and *B*.



Pioneer arrangement of straightaway track and dragline excavators employed in 1928.

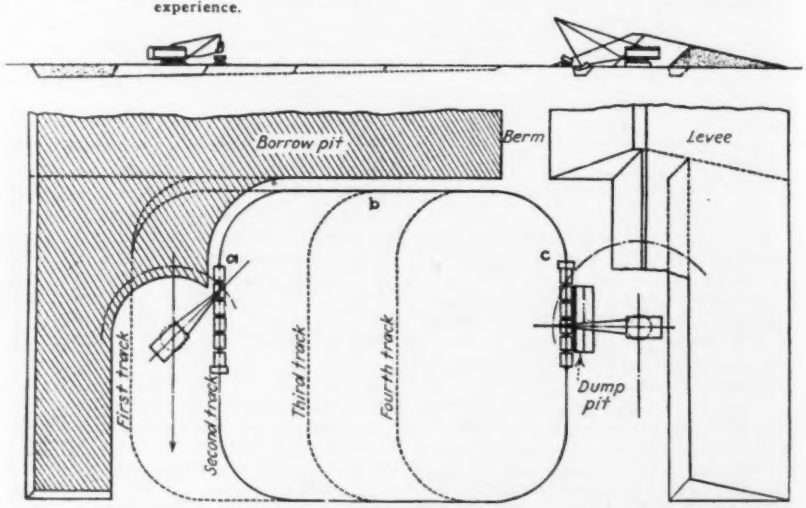
In this method of operation the loading dragline was idle while train 2 moved to *C* and was dumped, plus the time required for both trains to return to *A* and *B*. The levee dragline that removed the material from the transfer pit and placed it in the levee completed 60 ft. of levee from one position. It was then, with the track, moved ahead 60 ft. and a new transfer pit was excavated. This first use of the system proved that long-haul material could be handled cheaper by it than by any other system by which the moving load was carried directly on the natural ground. It also was able to maintain operations when every other haulage system had been shut down by weather and ground conditions.

The pioneer track arrangement described was followed by a continuous-loop track instead of a shuttle track. The side of the loop parallel to the levee is about 1,000 ft. long; its dimension normal to the levee depends upon the width of the borrowpit. As shown by the sketch, the ideal normal location of levee, berm and borrowpit is assumed. A variant of the arrangement that is sometimes used is an incomplete loop, as if, for example, the loop ends *a b c* were cut off. In this arrangement the side of the part loop next to the levee has a passing switch track by which the empty train going into the borrowpit passes the loaded train coming out to the transfer pit.

In both the full-loop arrangement and its variant the transfer pit is parallel to the levee line and inside the levee toe. It is continuously extended by the levee dragline and automatically filled as the levee fill advances. Two trains are operated as shown by Fig. 2. The levee is built complete in 70-ft. sections. The land-side toe is placed first, then the river-side toe and then the center.

Further developments in track arrangement have been variants of the straightaway and loop track. The advance has been in equipment. Standard-gage track replaced the light industrial railway. With the narrow-gage track, derailments were frequent and maintenance was troublesome. A more important advantage was the ability to use 12-yd. air-dump cars.

Standard loop track and dragline-excavator arrangement developed from pioneer experience.

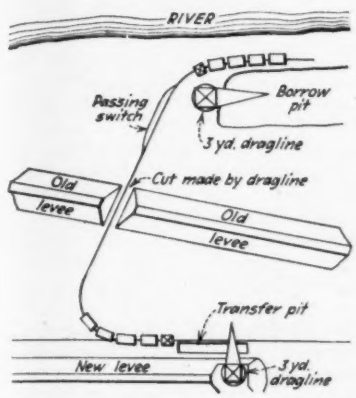


These dump quite as rapidly and are loaded with draglines with less spillage and care in spotting than the narrow-gage 4-yd. hand-dump cars first used. Steam locomotives also have proved to hold to the track better and to make the grades easier due to the throttle control. Larger draglines are used: for loading, a 2- or 3-yd. machine with a 75-ft. boom, and on the levee a 4-yd. machine with a 100-ft. boom. For the most part these draglines are diesel-powered, and all have walking or crawler traction.

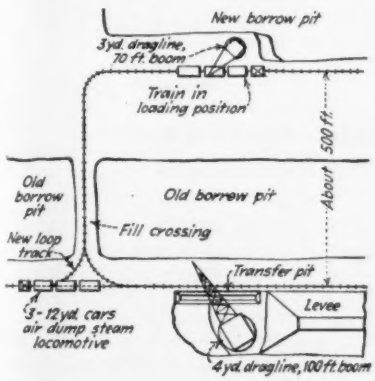
Examples of practice

The first installation of the Shea system was the loop-track type at Lake Cormorant, Miss., in 1928. This was a 2,000,000-yd. operation, and five outfits were employed, with small draglines, narrow-gage track and 5-yd. hand-dump cars operated in trains of six by gasoline locomotives. This pioneer outfit established the new system, which was more highly developed the same year on the Goodrich Loop levee.

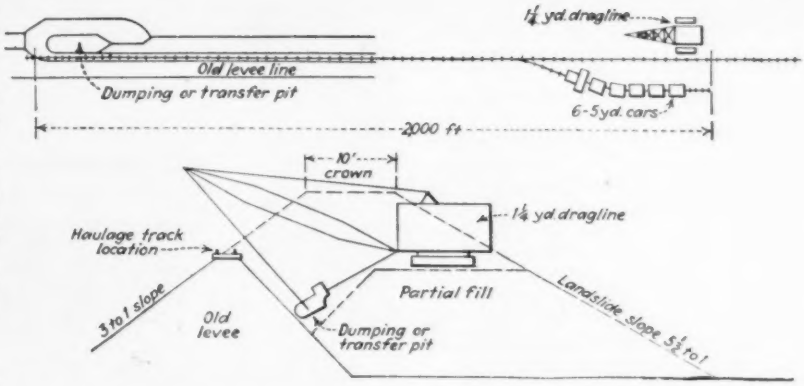
The Goodrich Loop was a small-yardage operation, requiring only one loop track, train and dragline outfit, but a striking advance was shown in equipment. The track was standard gage, and 12-yd. air-dump cars were used for the first time with this system.



Equipment arrangement for borrowing material from beyond old levee.



Equipment arrangement for borrowing material from beyond old borrowpit.



Equipment arrangement for levee enlargement from borrowpit at one end.

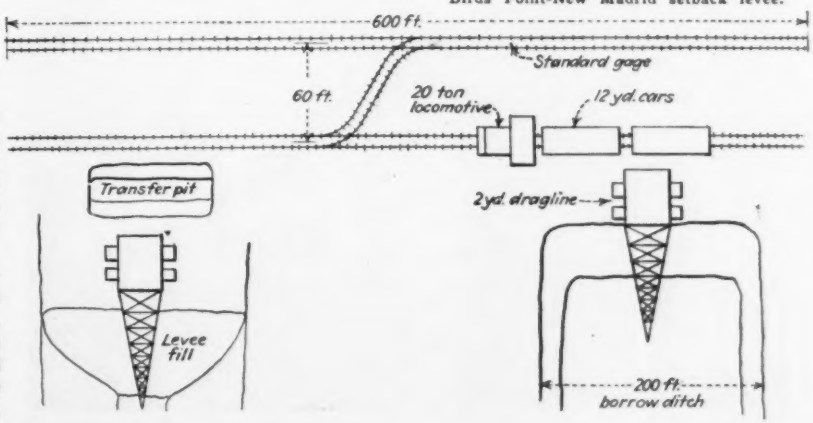
The draglines were larger, a 45-ft. boom 1½-yd. machine was loading, and an 80-ft. boom 3-yd. machine was at the levee. The levee dragline stood on the levee fill at a level about 3 ft. below the top and finished the levee to full section from this stand, the long boom and the walking traction enabling the operator to cover the full levee width and the transfer pit.

Working in a 75 per cent sandy loam easy to handle when dry, the average output was 60 two-car trainloads, or 1,440 cu.yd. in a twelve-hour shift. A train of two 12-yd. cars was loaded in 10 to 12 min., and the run to the transfer pit and return took another 12 min., making the full train cycle about 24 min. A reason for the good record was also the supervision, one of the two contractor partners supervising each working shift. In spite of careful watching to prevent delays, the lost time was 30 per cent of the working time.

In 1929 a railway-haulage installation of the straightaway type was employed near Hickman, Ky., on levee enlargement. The borrowpit was a hillside about ½ mile beyond one end of the enlargement. Filling was begun at the end farthest from the pit, a single track being laid along the old levee from the pit to the point of fill. As the enlargement progressed toward the pit the track was taken up. The transfer pit was excavated in the old levee alongside the track and was automatically refilled as the enlargement progressed. The trains were narrow-gage 5-yd. dump cars hauled by gasoline locomotives. A part of the Bonnet Carré floodway levees near the spillway was constructed in 1930 by the Canal Construction Co., by which the Shea system was developed. This work required a long haul for which the system proved exceptionally successful. The most notable of the systems in 1930 was, however, on the Birds Point-New Madrid setback levee. This installation was fully illustrated and described in *Engineering News-Record*, April 16, 1931, p. 640.

Improvements required

The particular advantage of the railway in levee construction is that it increases the haulage range. Railway track provides a travelable way under weather and ground conditions that prohibit any other means of surface haulage. It therefore prolongs the working season and reduces the number of shutdowns due to days of bad weather during the working season. A railway permits higher speeds and so increases the possible length of haul. It enables material to be taken from a borrowpit beyond any natural obstruction with the least possible trouble in getting a roadway through the obstruction. An example is a borrowpit beyond an old levee; a cut through the old levee will provide for a single track which on



Double straightaway railway used on Birds Point-New Madrid setback levee.

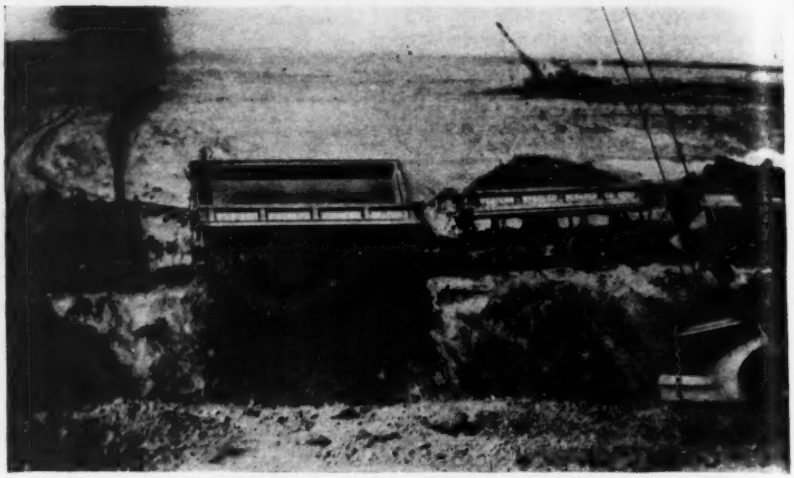
either side of the cut can be fanned out into any desired system of pit or distribution tracks. An important advantage of the method is that the full levee section is completed as the equipment moves ahead.

The number of working units that, to insure full output, must perform in absolutely synchronous coordination is the present imperfection of the system that requires improvement. Results do not indicate efficiencies exceeding 75 per cent and averaging more than 50 per cent of the theoretically possible output. Intermittent operation of the various units contributes heavily to idle time. The draglines of present-day dependable design and construction should insure expected performance. Similarly the dump cars and locomotives can be depended upon for full performance. The weak point is that they all must depend on a track laid on insecure ground and with poor ties and ballasting. The results are derailments, rail breaks, etc.

Track moving is a major cause of time delays that cut down the yardage flow to the fill. A plan for placing a new loop while the old loop is in use has been proposed, but this requires expensive track equipment. A large crew and tractors are required to move the track. If an old borrowpit is to be crossed or if a cut is required through an old levee loop, the fill and excavation must be made by an extra dragline machine. The ballasting can be kept in fairly good shape on a loop system during the summer months, as the loop plan does not include a constant changing of track location. Even close attention to the track during the seep-water season is not sufficient to meet the ever-changing ground conditions due to seepage.

The levee-building dragline is generally idle 40 per cent of the time on a long-haul job, as this machine is required to mount a long boom owing to the enlarged levee dimensions, and the long-boom equipment always carries a larger bucket than is necessary to handle the yardage that is loaded by the smaller dragline at the borrowpit. This larger dragline can handle all the material from the transfer pit and do all the other work required, and still have the delay mentioned. The smaller dragline at the borrowpit location is busy during the loading operation, but between trains the machine is often idle in spite of the fact that the operator, while waiting, generally handles the materials into position for fast loading.

The loop-track system requires an expensive layout, and the curves are always dangerous in rainy weather to a fast-moving transporting unit. The straightaway track system, in spite of the changing location, is better. The ties are generally of local timber; this round timber is not stable and does not give the rail proper support. The ties roll under the loads, and continual shifting of the straightaway operation destroys the tie timber in a short time.

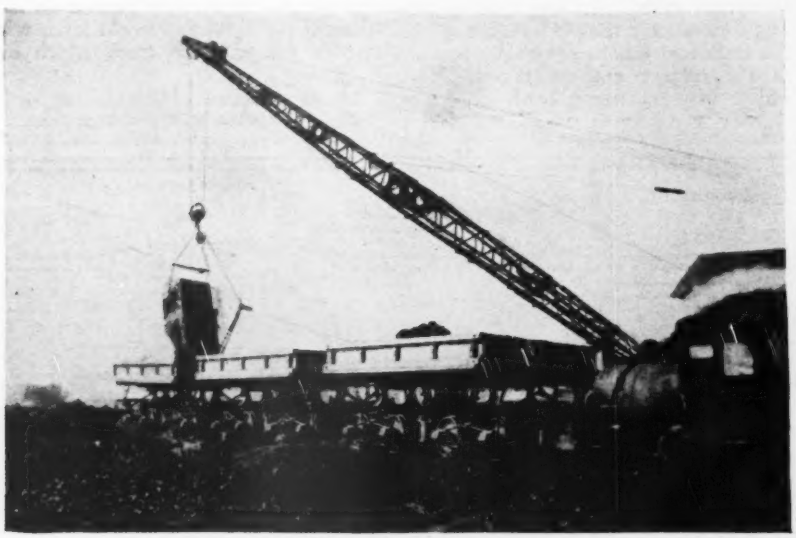


Cars dumping into transfer pit from which dragline handles earth into levee.

Track maintenance and replacement, cars and locomotives jumping the track, dragline-machinery adjustment and repairs, weather and ground conditions interfering with the placing of the center and topping sections of the levee are a few of the daily delay problems that retard the yardage flow to the levee. Steam pulling locomotives are now under test on the work. Coal and water supply for these units create another item in the difficulties of the contractor.

Railway-haulage equipment will doubtless continue to be a factor in the levee-building work on the river. New contractors will try the plan on their newly acquired projects, and the additional use of the system plus the additional ideas of the new users may overcome the present drawbacks to greatest success.

Dragline loading large-capacity air-dump cars at borrowpit.

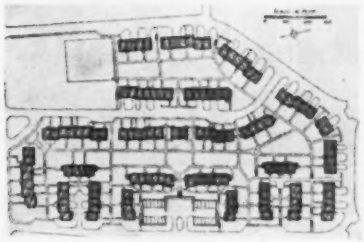


France Plans $20,000,000 Port Improvements

The French government has recently made available $20,776,000 for the extension, improvement and restoration of ocean ports, according to a report from consul Howard F. Withey, of Paris, to be divided among large ports, medium ports and fishing ports, with $11,760,000 and $6,860,000 for the first two sizes, respectively. In addition, $1,176,000 has been appropriated for lighthouse improvement. Included in the work to be undertaken is the extension of the Dunkirk breakwater to provide an outer port. At Havre certain channel deepening will be carried out as well as other improvements. At Rouen the dock construction provided for by the law of 1913 will be completed, and certain rectifications along the banks of the Seine will be accomplished. Among the medium-sized ports the Boulogne breakwater construction will be continued. At St. Nazaire it is planned to construct a large lock for use in major ship-repair work.

Large-Scale Housing— A Need and a Business

Conference of architects, builders and housing agencies focuses attention upon need of housing for small-income group—Success depends on new methods of financing, lower construction costs and improved materials and technique



Plot plan of Chatham Village, first unit of the Buhl Foundation in Pittsburgh, which was completed this Spring. Row houses with their backs to the street and fronting on interior lawns were built on rough hillside land to rent to the income group of $2,400 per year or more for $11 per room per month average. The project is also notable for the comprehensive study of housing needs and investment risk that preceded actual construction.

AT a two-session meeting in New York on April 13, arranged by the housing section of the Welfare Council and the Housing Association of New York, architects, engineers, builders and representatives of financial institutions came together to consider large-scale operations as a solution of the housing problem. That there is a problem was made plain by all the speakers. The locus of the problem, as it was considered at this meeting, was largely urban—rehabilitation of blighted or slum areas and building of entirely new developments in outlying districts. The need considered was for well-built and lasting construction that could be provided at rentals as low as $7.50 per room per month.

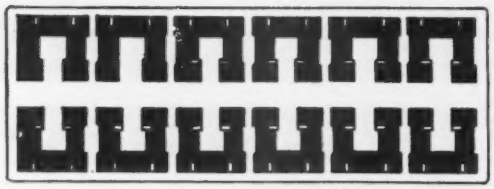
The "own your own home" idea, which has been so forcibly urged for several years, was believed by most of the speakers to be out of the question for the income group whose housing needs are greatest. Workers are too transient in the present-day scheme of things to be expected to appropriate all of their savings to the purchase of living quarters that they may at any time have to give up at a loss. While the need for housing is apparent and large-scale operations are generally accepted as the best means for meeting it, financing methods are difficult to agree upon and even more difficult to make practical and immediately usable. One entire session of the conference was devoted to the financing phase of the problem.

In introducing the meeting Clarence S. Stein, architect, New York, pointed out that while there are in existence a number of large-scale housing developments, most of these followed small-scale practice in that as many structures as possible were grouped on a given piece of ground and speculative building practices and financing were indulged in, with the result that the developments are prey to easy and rapidly depreciation both physically and socially. The need is for housing, said Mr. Stein, the value of which is permanent and protected from the danger of changes in the character of the neighborhood, and where open courts and lawns are as much a part of the scheme as the structures themselves. The housing need is most marked for the low-income group, $1,800 a year and under, which comprises the mass of our population.

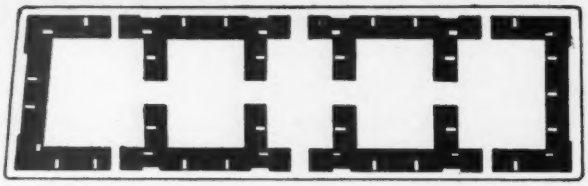
Sentiment and politics have previously enveloped the housing problem to its great detriment, said Alfred K. Stern, chairman of the committee on large-scale operations of the President's conference on home building and home ownership and director of the Julius Rosenwald Fund. The housing need, if it is to be met, cannot be solved by sentiment but must enlist capital on a sound basis. Sentiment also must be eliminated in discussing the single house versus the apartment. In Mr. Stern's opinion there has been too much "own your own home" propaganda. A person of low income can probably never own his own home, not only because of financial considerations but because in this industrial age he is called upon to be in large measure a transient.

Mr. Stern pointed out that most existing projects that have involved any considerable amount of careful planning and construction have been philanthropic or semi-philanthropic in nature and aggregate something over $70,000,000 so far. Banking interests have been prone to

In Radburn, N. J., most notable of modern planned developments, the single or two-family house predominates, although several apartment buildings have been included. Basic features of plan are complete separation of streets and walks with all buildings on dead-end service streets and fronting on "backyard" lawns instead of on the streets.



Left: Typical block housing completed in Queens, New York City, in 1923 by Metropolitan Life Insurance Co. Buildings of 3,323,760 cu.ft. cover 30.36 per cent of the plot. Land cost was $142,000; building cost, $1,708,000; capital cost per room, $880; built to rent for $9 per room per month.



Right: The Chellis Austin Apartments in Newark, N. J., completed in 1923 by Prudential Life Insurance Co. Buildings of 4,000,000 cu.ft. cover 39.7 per cent of the plot.

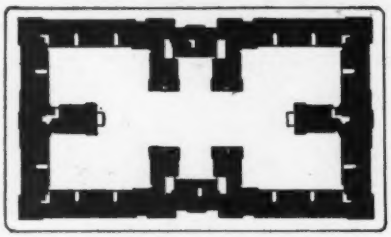
call these projects charity, but Mr. Stern stated that most of them have been showing earnings, although not the high speculative profits that are usually associated with building projects. Mr. Stern quoted the late W. A. Starrett as stating that social validity must be added as a factor in considering the housing problem, that this factor has not been present in skyscraper or industrial plant building and is therefore quite a new conception, and that its acceptance means that profits on housing developments cannot be expected to be as large as on former speculative enterprises.

Mr. Stern offered the specific proposal for the construction industry and its allied material manufacturers to take the problem out of the hands of the bankers and handle the financing and planning themselves. Such a move is logical because these interests have a larger stake in the outcome than have the bankers. As a beginning, he suggested that the leading engineers, architects and contractors in each community combine their talents in planning specific projects, carrying these to the actual blueprint stage and then presenting the proposal to the construction industry (large contractors and materials interests) as a profitable business venture. He indicated that some of this type of planning is now under way in one or two cities.

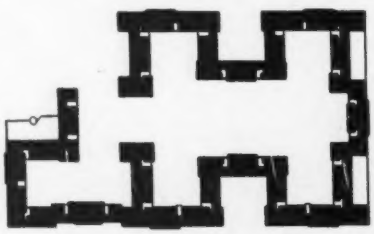
It is important in this connection to remember, he said, that private industry can do only as much as is economically sound. A small profit, however, such as is possible through limited-dividend, state-supervised corporations is acceptable in these times to many business men who have not been interested during times of prosperity. Some sort of state supervision seems necessary so that the securities of such companies may attain the standing of those of any other public utility. It is extremely important, he pointed out, that the initial project developed under such a plan shall be exceptionally conservative and safe. If such a development can be proved to be profitable, he feels that outside capital will voluntarily become available.

In discussing housing needs Robert D. Kohn, president of the American Institute of Architects, emphasized the necessity of thinking of them as a social problem, approached from the utilitarian point of view rather than from the outmoded "city beautiful" idea of a number of years ago. City plans based on fine renderings of wide streets, plazas, statuary, etc., set back any real accomplishment in city planning for at least 25 years; and he fears that some such situation may develop in the housing field if the sentimental approach controls. Mr. Kohn minimized the effect of new materials and new methods in solving the problem, stating that it is more necessary to consider the kind of dweller to be served and his wants and his habits and then utilize available materials.

Mr. Kohn agreed with Mr. Stern and other speakers in holding that projects should be planned in almost complete detail before they are taken to bankers



Phipps Garden Apartments in the Sunnyside development in Queens was completed in 1931. Buildings of 3,387,951 cu.ft. cover 45.94 per cent of the plot. Land cost, $380,000; building cost, $1,416,595; capital cost per room, $1,170; built to rent for $17 per room per month.



Michigan Boulevard Garden Apartments, a negro housing development completed in Chicago in 1929. Buildings of 3,900,000 cu.ft. cover 50 per cent of the plot. Land cost, $355,000; building cost, $2,702,000; capital cost per room, $1,490; built to rent for $16.50 per room per month.

or other financing agencies, thus reversing the usual procedure, which is for the financial interests to dictate what the construction industry shall build. Although Mr. Kohn recognized that governmental help is needed in many ways, he feels that the larger part of the task is up to the construction industry itself. At the present time bankers hold mortgages on the blighted areas and are therefore unresponsive to any development of these areas that will jeopardize their investment. Mr. Kohn pointed out that the construction industry has not only the technique, ability and organization but also the capital within itself to carry out rehabilitation of such blighted areas. In short, the proposition should be attacked from the point of view of the need of the housing rather than from any consideration of the amount of profit, at the same time recognizing that some profit is necessary.

Reduce construction costs!

The builder's great opportunity to assist in solving the housing problem through large-scale developments, said Andrew J. Eken, vice-president, Starrett Bros. & Eken, Inc., is in reducing construction costs. Although these costs have fallen at least 25 per cent in recent years, they are still far above the level where adequate housing for the low-income group can be provided at a profit. Under present practice housing construction involves too much risk and too little return for the large builder to be interested in it. However, if the risk were less, the lower profit would not be a stumbling block. If large-scale housing developments can be shown to be at all profitable, and if risk can be reduced to a minimum, capital will flow into them voluntarily, said Mr. Eken.

Costs can only be reduced by new materials and new methods that are cheaper and better. Standardization of materials and building units is a necessity exceeded in importance only by mechanization of building operations in the field. At the present time field labor accounts for about 35 per cent of the cost of building, according to Mr. Eken, and mechanization should be able to reduce this considerably. New materials, he pointed out, do not necessarily mean unheard-of materials but the utilization of different and better materials in the place of present inferior construction and at a lower cost.

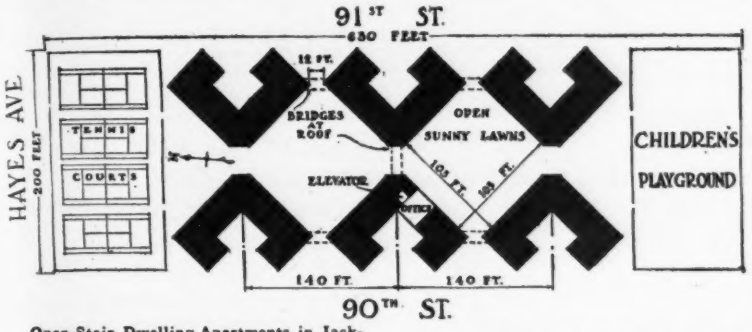
Research now is largely concentrated in the hands of manufacturers who are handicapped by not having available the cost figures and technical knowledge of the builder and the architect. Mr. Eken referred to one group at the present time that includes manufacturers, architects and builders, which is planning a research program that should yield important results. Financing large-scale housing developments by the construction industry is a possibility, conceded Mr. Eken, but will be difficult

of accomplishment because of the loosely knit and uncooperative character of the industry.

Housing finance

Throughout the sessions financing was emphasized as the crux of the large-scale housing problem. Methods of providing suitable living quarters for the low-income group to rent for as little as $8 per room per month, and methods of making such housing attractive to the investor were discussed at an evening session, where financing by banks, insurance companies, government credit, cooperatives and foundations was considered by representatives of these interests. Although most of the suggestions were local to New York, they were also shown in many instances to have application elsewhere. For example, William Sloane Coffin, vice-president of the City Housing Corp., proposed a financial structure for a housing company that might be utilized anywhere. Assuming a capitalization of $25,000,000, he proposed that $15,000,000 of 6 per cent first-mortgage bonds be made the senior securities, followed by $5,000,000 of 6 per cent preferred stock, and $5,000,000 of limited-dividend common stock. He emphasized the fact that housing developments made by such a corporation must be in every respect as sound as public utilities; that the bonds must be of a type suitable for savings-bank portfolios, and the preferred stock of a high investment rating. He suggested that the common stock be taken by wealthy civic-minded individuals or groups who could stand a loss if necessary and who in case of profit would be willing to forego anything above 6 per cent in the interests of the company. Such a corporation, Mr. Coffin pointed out, could exchange some of its senior securities for existing mortgages held on the land and property desired for development. The problem of existing mortgages and their liquidation is a difficult one and was believed to explain in large measure the attitude of many bankers toward large-scale housing.

Orrin C. Lester, vice-president of the Bowery Savings Bank, presented an example of the difficulties that confront the banks which have a large stake in blighted areas. As president of the Lower East Side Planning Association, Mr. Lester is actively engaged in a study of ways and means of protecting the investment of banks and mortgage companies in one of the worst of New York's blighted areas. The members of the association include representatives of five savings banks, two title companies and four civic associations. Their hope is to sustain values in that section, where the assessed 1922 valuation was $300,000,000, including $177,000,000 assessed on the land. They are faced with the situation that the $123,000,000 worth of structures are worthless for reconstruction, and in some way this value as well as the cost of demolishing the structures must be absorbed.



Open-Stair Dwelling Apartments in Jackson Heights, Queens, features stairways in interior corners of each six-story building and no horizontal halls. Elevators run express to the roof, permitting tenants to walk down instead of up. Bridges connect roofs of the several units. Capital cost per room was $1,500; built to rent for $14.25 per room per month average.

The study of some means of rehabilitation is based upon the assumption that mortgage money will not be attracted to such run-down areas until a really constructive plan of improvement is presented. Admitting that mortgage loans in the future will be appraised not only on the risk involved and possible return but also on the social need of the investment, Mr. Lester nevertheless stated that the banks' altruism in the latter regard can go only so far as sound business dictates. If social needs are to attain any weight as a factor in determining investment, assurance of stability of the neighborhood is absolutely essential. One of the corollaries of such stability is that rents must be placed at a high enough level to attract and keep the proper type of resident. Mr. Lester indicated that he did not believe the $7 and $8 per room per month rents, which other speakers had mentioned, are high enough when measured by this standard. At present a fundamental plan is being laid down for the lower East Side. With a fundamental plan available, it may then be possible to form a housing corporation to go into large-scale work, but lending institutions will require some safeguards for stability in neighborhoods whose reconstruction they finance. This stability may have to be provided in part by the city.

In discussing financing by insurance companies, Willard I. Hamilton, vice-president of the Prudential Life Insurance Co., stated that more examples of successful large-scale developments are necessary in order to persuade banks and insurance companies to regard them as sound investments. His own company has just completed an important development in Newark, N. J., covering 39 per cent of the area of a 700x200-ft. block with walk-up fireproof apartments, leaving the remainder of the plot open as a park. There are 406 apartments and 1,612 rooms in six buildings. The company invested about two and a half million dollars to return 4 per cent and built the structures to rent for $12 to $14 per room per month. In the three months since the development was completed 201 of the 406 apartments have been rented to persons with an average income of $2,240 a year. The income range is from $700 to $7,000. The company is also interested in developing another plot in which it is hoped that the city will contribute the open park spaces and the insurance company merely lease the land upon which the buildings stand. The legality of such an arrangement is being tested at the present time in the New Jersey courts, and it is believed that it will be upheld.

Need for government credit

In pointing out how far we are behind Europe in housing developments for low-wage groups, Paul Blanshard, executive director of the city affairs committee, urged the absolute necessity of our adopting the European view in which housing is considered as much a public function as subways and roads. Mr. Blanshard pointed out that the government can borrow money at a low enough rate to build houses that can rent at least $5 a room cheaper than houses constructed by private investors. For example, the money borrowed for building in New York City by private builders actually costs from 9 to 10 per cent, whereas state funds in normal times can be secured for 4 per cent.

The average factory worker in New York, said Mr. Blanshard, does not receive more than $30 a week, and on the basis of spending one-fourth of his salary for rent, he cannot afford a four-room apartment that costs more than $7.50 per room per month. No decent housing is available in New York for anywhere near that figure, said Mr. Blanshard.

Governmental credit is necessary not only because speculative building costs are too high but also because the limited-dividend and cooperative corporations are failing to attract enough investors' money at the 6 per cent return that they promise. Some countries in Europe use an outright subsidy. Mr. Blanshard is not in sympathy with such a procedure for this country but feels that public housing can be made as self-supporting

as other public utilities, citing for comparison the bridges of the Port of New York Authority.

In New York the present state housing board, in Mr. Blanshard's opinion, is thoroughly competent to administer a proper housing program, but the state housing laws need to be amended to permit municipal housing and the extension of state credit. Also, an appeal should be made by both state and city to the federal government for a large loan for public housing. The immediate need, said Mr. Blanshard, is the passage of laws that would amend the state constitution to permit the use of public credit for housing and the creation of a municipal housing department in New York City.

Financing by foundations was discussed by Henry Wright, architect, New York, with specific reference to the recently completed Chatham Village of the Buhl Foundation in Pittsburgh. In the opinion of many, this development is based upon the most thorough and intensive analysis yet undertaken for a housing project. Mr. Wright stated that this analysis demonstrated without question that trust-fund money may safely be invested in good large-scale housing developments. Chatham village was planned and built to suit the salaries of clerical workers in downtown Pittsburgh. Starting on the supposition that the development should involve single houses that could be sold, the results of the financial analysis reversed this plan entirely so that actually row dwellings were built to rent. The lowest income group reached was $2,400. The average rent per room per month for the entire project was about $11. More than 500 formal applications were received in the first two weeks after the rental schedules were announced, and during this same time 90 of the 125 available leases were signed, indicating, according to Mr. Wright, the absolute soundness of the investment for trust-fund and foundation purposes.

Mr. Wright also pointed out that the project has demonstrated that hillside land may be used very effectively for housing development. This project combines two of the new conceptions of housing arrangements that were adopted, respectively, in the Sunnyside and Radburn developments of the City Housing Corp. of New York. In Sunnyside row-houses are used, and in Radburn the single-family houses are placed with their backs to the streets and their fronts toward interior lawns. At Chatham Village the row-houses were placed with their backs to the streets. Although a somewhat higher-income group actually leased the houses than was planned for, the project was considered a success because it was actually built in line with the clerks' salaries as shown by the survey.

As president of the Amalgamated Housing Corp., Abraham A. Kazan presented the advantages of cooperative ownership of apartments, including permanence of tenancy, lower maintenance costs, an approach to better community life. Mr. Kazan pointed out that a fund of 2½ million dollars would provide credit enough to build 6,000 rooms or accommodations for 2,000 families. Cooperatives, he also believes, could assist the administrators of trusts in disposing of or utilizing land that they hold by exchanging this land for stock in the cooperative. The building materials' manufacturers were also mentioned as being in a position to accept stock in sound cooperative enterprises as payment for services rendered.

Mass Concrete Problems Discussed at Meeting

Investigations for Hoover Dam cement and concrete provide major theme for second meeting of American Concrete Institute committee on mass concrete—Other topics include relation of heating effect and strength to chemical composition and reports on field investigations

WITH EMPHASIS on the cement and concrete studies now under way for Hoover Dam, but including such general topics as heat of hydration, laboratory control methods and current field investigations, the second meeting of the American Concrete Institute committee 108 on properties of mass concrete, held at the University of California, Berkeley, brought out important new material on this subject. The session was the first meeting of the entire committee since its organization in November, 1930, although various groups had met in the interim. Prof. R. E. Davis, University of California, stated that the laboratory program to date has been largely confined to study of Hoover Dam problems; because of their fundamental nature, these will be of value for all mass concrete work.

Laboratory investigations

P. H. Bates, U. S. Bureau of Standards, outlined briefly the research program being conducted on cement and concrete for Hoover Dam. Starting with fundamental studies on chemical composition of cement as related to heating and strength, the research has expanded into problems of concrete, including phases of heating effect, rate of placement and effect of refrigeration.

Size of Specimens — Investigations conducted by the Bureau of Reclamation in the Denver laboratory and at Owyhee Dam were outlined by B. W. Steele. On the question of laboratory procedure for testing concrete with large aggregate, extensive experiments are being conducted with specimens from 3x6 in. to 36x72 in. in size to determine the relative results obtained. In connection with this work new equipment has been developed to grind cylinder tops to a tolerance of 0.002 in. for a 36-in.-diam. specimen.

The size of 36x72-in. test specimens presents problems in hand placing, to make results comparable to those obtained by hand rodding in the smaller sizes. As a result, studies have been made on the use of vibrators in an effort to secure consistent characteristics for all sizes of test specimens.

Grouting Tests—Tests are also under way covering the coefficient of thermal expansion, thermal diffusivity and conductivity of concrete and questions of grouting. On the latter subject, work is under way in studying proper water-cement ratio and the width of crack necessary to insure proper grouting. As a preliminary to this study, cores were drilled from the Gibson Dam to observe the result of the grouting done on that structure. These cores were drilled from the crest at angles of 45 deg. across vertical joints. Disregarding a few extreme observations, the average thickness of the grout film or the average crack opening at the time of grouting was 0.027 in.

Tentative conclusions are that a minimum crack of 0.01 in. is required for proper grouting, and a crack with a width of 0.03 in. will provide better flow. Further information is to be obtained by grouting test blocks in the Denver laboratory, and operations will be made during the placing of the last sections of concrete in the Owyhee Dam.

Cement and Concrete—The program of study on Hoover Dam cement and concrete problems now in progress at the University of California was outlined by Professor Davis. Eighteen commercial cements ground to five different degrees of fineness (from 75 to 95 per cent through a 200-mesh sieve) were supplemented by eighteen commercial clinkers ground under laboratory conditions to insure uniformity of particle size distribution, and it is planned also to study 22 special cements prepared

from specifications written as a result of the work to date. The properties to be observed include (1) heat generation and rate; (2) factors of strength; (3) volume change due to air drying and to water soaking; and (4) durability.

Various parts of the laboratory equipment and work were then described, including temperature-control apparatus, equipment for heat-of-solution tests to determine heat generation characteristics, tests of plastic flow under sustained stress, mathematical studies of temperature distribution in concrete as deposited in the dam, and the Carlson strain-meter developed by R. W. Carlson of the laboratory staff. The original design of this device for the measurement of strains in concrete by the variation in resistance of a steel wire under differing tension (*ENR*, Oct. 15, 1931, p. 615) has been improved and is being used extensively in the testing of the large specimens and in the field investigations now under way on Owyhee Dam.

Tests on determination of elasticity and plastic properties of mass concrete under axial, bi-axial and tri-axial sustained loading have been curtailed because of lack of funds. Study of the effect of pipe refrigeration will be made on large test specimens.

Chemical Composition of Cement—Investigations carried out by the Riverside Cement Co., Riverside, Calif., under the direction of Hubert Woods, cement chemist, were described by H. H. Steinour and H. R. Starke. The investigations on heat indicated that it is possible to write an equation for the amount of heat of hydration expressed in terms of the four principal chemical constituents of cement, each modified by a constant. The principal heating effect was found to come from tricalcium aluminate and tricalcium silicate, in the ratio of 2.1 to 1; the other constitutents are of only minor importance. General results indicated that portland cement produces heat of hydration for more than six months, although the major portion of the heat is liberated within three days. Changes in chemcial composition can be made to control the heating effect. The per cent of tricalcium aluminate is of primary importance, with tricalcium silicate next. The cements high in dicalcium silicate were found to be particularly low in heat generation.

In reference to strength, quick rise and early strength are dependent primarily upon the amount of tricalcium silicate. By the end of six months, however, the advantage of the high tricalcium silicate is largely balanced by the gain in strength of dicalcium silicate. The two silicate compounds are primarily the strength-producing factors; tricalcium is the early-strength element, whereas dicalcium produces the later strength.

Field investigations at the Owyhee Dam, to provide information on the effect of refrigeration cooling as proposed for Hoover Dam construction, were described by B. W. Steele, Bureau of Reclamation. Last summer a test refrigerating system of pipes was embedded in a section of the concrete then being placed; river water was pumped through this system for a period of about eighteen days, and heat removal was observed. The results were principally qualitative, but they proved that the advance calculations were correct within 1 or 2 deg. of temperature. As a result of this preliminary test two of the upper sections still to be placed at Owyhee are being equipped with a refrigerating system and an extensive system of registering devices, including temperature and strain-meters, crack-measuring instruments and equipment for determining volume change Cool river water will be circulated when the concrete has reached its highest temperature to determine the effects of rapid cooling. The results should indicate the strain from cooling in addition to data on cracks and volumetric change.

Uplift—Field investigations made on the Bull Run and Ariel dams were described by D. C. Henny. On the factor of uplift the results obtained on both structures indicated that uplift pressure drops 75 per cent in the first 15 per cent of base width measured from the upstream face, and then continues to decrease along a practically straight line to the downstream toe. Uplift on horizontal construction joints is almost negligible.

Results of a second series of grouting operations on the Pardee Dam and the effect on seepage were outlined by F. W. Hanna, chief engineer and general manager, East Bay Municipal Utility District. The second grouting is practically complete and has been carried on to reduce seepage resulting from the shrinkage following the gradual dissipation of heat in the dam, which was built at a particularly rapid rate because of impending water shortage. Shrinkage was still in progress, and a third grouting operation may be required at a later date. The second grouting has been effective in eliminating 75 per cent of the seepage through the structure.

How an Activated-Sludge Plant Was Started

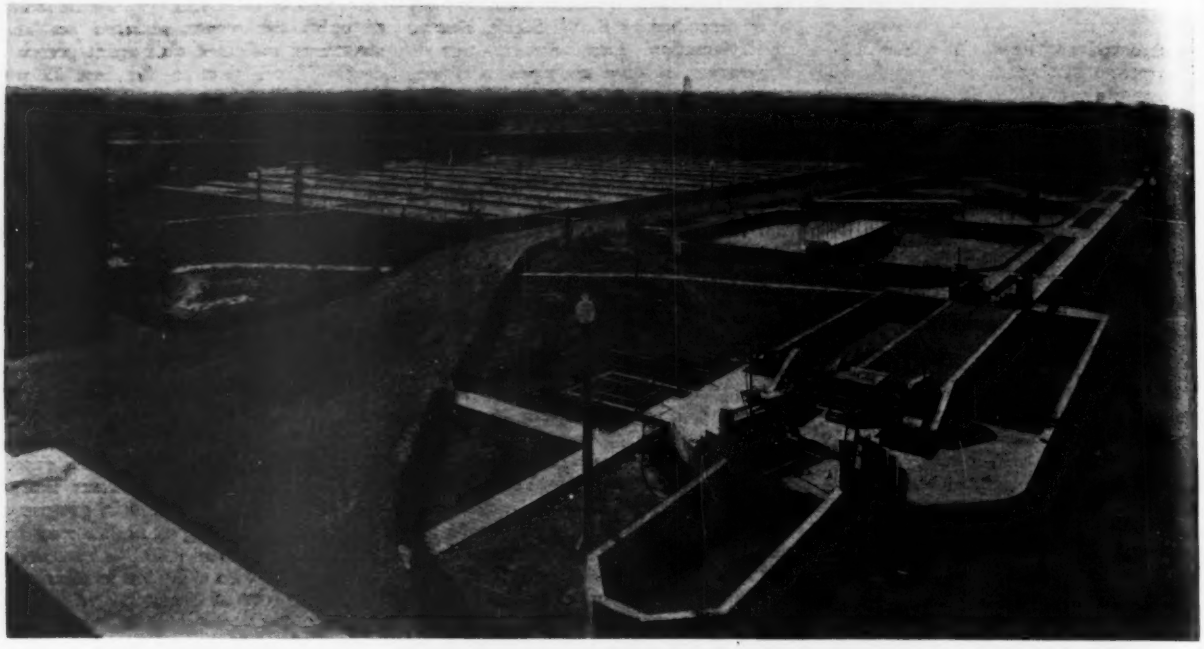
Peoria procedure involved part treatment in early weeks and non-use of activation tanks until the sludge was matured in the digesters

IN STARTING the operation of the new activated-sludge sewage plant at Peoria, Ill., a period of four weeks was necessary from the day sewage was first admitted until all plant units were functioning. For the first few days screening, grit removal and primary settling only were used. After digestion of the primary sludge was well established, the aeration units were put into use. A report of the operation of the plant during its first half-year of life was presented by L. S. Kraus, superintendent, at the recent meeting of the Illinois Engineering Society.

The plant is intended to take a flow of 90 m.g.d. Two sets of bar screens are provided: one to protect the pumps, with 2⅜-in. openings, and one ahead of the grit chamber with 1½-in. openings. The grit chamber is provided with continuous grit-removal apparatus. There are four primary settling tanks, equipped for continuous sludge removal; four batteries of aeration tanks, each consisting of three spiral-flow channels; and four final settling tanks. There are four digestion tanks, provided with heating coils and stirring mechanism. Two sludge-storage tanks, with a capacity of 850,000 cu.ft., afford winter storage of sludge. There are 28 open sludge-drying beds, each having an area of 10,000 sq.ft.

The treatment plant was placed in operation on May 15, 1931, when sewage was admitted into the four primary tanks. Primary sludge was pumped into one of the digesters. The primary-tank effluent was bypassed to the river with the intention of not using the aeration tanks until at least one digestion tank was operating normaily.

The digestion tank into which the sludge was pumped was equipped with a temporary live-steam heating coil placed 5 ft. from the bottom. Steam was supplied from a portable boiler. Sufficient river water was added to cover the steam coil, and its temperature was brought to about 87 deg. F. Sludge was added daily, beginning on May 17, and the temperature was kept between 87 and 90 deg. F. The pH of the sludge dropped steadily from 6.7, until it was at 6.3 on May 20. On the following day 500 lb. of lime was added, and the pH rose to 6.5. It was considered necessary to add lime daily in 500-lb. quantities until the pH of the sludge remained reasonably constant. After twelve days a total of 3½ tons of lime had been added, and the pH of the sludge was up to 6.9. Liming was then



New Peoria sewage plant uses the activated-sludge process and comprises a screen-protected grit chamber, tanks for primary settling, aeration, final settling, sludge digestion, sludge storage and sand beds for sludge drying.

discontinued. The primary-tank sludge contained 60 per cent volatile matter. After two weeks the volatile matter in the digested sludge was 45 per cent. Gas collection was begun on June 10, and on June 29 the production reached 97,000 cu.ft. per day.

No uncontrollable foaming in the digestion tanks was experienced, although on two occasions the formation of foam was observed. In each case 300 lb. of lime was added in 25-lb. charges over a period of three hours, and the tank contents were recirculated; no foam was present on the following day. The presence of water sprays in the gas domes allowed the uninterrupted collection of gas during the second foaming period.

On June 22 the temporary heating was abandoned, for sufficient gas was being produced to maintain the tanks at a temperature of 90 deg. F. The other digesters were started by seeding with sludge from the one in operation. They were heated with gas also taken from the first tank.

The aeration and final tanks were placed in operation on May 28. In one week the removal of suspended solids was 90 per cent. In two weeks the aeration-tank solids were 2,000 p.p.m., and normal purification was established.

Activated sludge was at first wasted directly to the digestion tanks, but it was found that because of the low concentration of solids (1.5 per cent) it would be more satisfactory to waste to the influent of the primary tanks.

During the period from August to December, 1931, the plant treated sewage having a population equivalent of 112,000. Of this, 25,000 was due to industrial wastes. The average sewage flow to the treatment plant was 10.5 m.g.d.

The screenings obtained amounted to 2.5 cu.ft. per million gallons and contained 80 per cent moisture. The mean velocity in the grit chamber was 0.3 ft. per second. The grit removed amounted to 9.2 cu.ft. per million gallons of sewage. Grit analyses indicated 42 per cent water, 35 per cent volatile matter and 2 per cent putrescible solids. The return sludge of 2.5 m.g.d. kept the aeration-tank solids at about 2,800 p.p.m. The detention period in the aeration tanks was ten hours, and the air used averaged 1.1 cu.ft. per gallon of sewage. The settling rate in the final tanks was 700 gal. per square foot per day.

Sludge was pumped hourly from the primary tanks to two of the digestion tanks. It contained 4.8 per cent solids and 62 per cent volatile matter. The digesters were maintained at a temperature of 90 deg. F.; the raw sludge when added had an average temperature of 68 deg. F. The digested sludge contained 5.5 per cent solids, 47.3 per cent volatile matter, 2.8 per cent nitrogen and had a pH of 7.0.

Gas production averaged 98,700 cu.ft. per day. The gas contained CO_2, 32.3 per cent; CH_4, 63.0 per cent; N_2, 4.7 per cent.

Some difficulty was encountered with the maintenance of supernatant liquor. It seemed that when the gas production in a single tank reached 3,500 cu.ft. per hour the line of demarcation between sludge and liquor could not be maintained. It was found necessary to operate another digester as a secondary stage for the purpose of concentrating the sludge and producing suitable supernatant liquor. Under these conditions 10 per cent more gas was obtained, and the supernatant liquor was of a satisfactory nature, as indicated by the average December analyses below:

Suspended solids, p.p.m.	580
B. O. D., p.p.m.	200
pH	7.4
Org. matter plus NH_3, p.p.m.	760
NH_3, p.p.m.	720

Pearse, Greeley & Hansen, of Chicago, were the consulting engineers.

TABLE I — OPERATING DATA OF PEORIA SEWAGE-TREATMENT PLANT. AUGUST TO DECEMBER, 1931

	Raw Sewage	Primary Effluent	Final Effluent
Population equivalent	112,000	79,000	3,400
B. O. D., p.p.m.	213	150	6.5
Suspended solids, p.p.m.	229	129	13
Organic N plus NH_3, p.p.m.	23.4	23.2	4.7
NH_3, p.p.m.	11.4	12.3	2.3
Dissolved oxygen, p.p.m.	0.4	0.2	3.1
NO_3 plus NO_2, p.p.m.	.....	.....	6.1
pH	7.4	7.4	7.7
Bacteria per cc.	1,400,000	1,100,000	6,200
B.coli per cc.	440,000	200,000	2,000
Per cent removal B.O.D.	.....	30.1	96.5
Per cent removal suspended solids	.....	43.8	94.3
Per cent removal bacteria	.....	.....	99.6
Per cent removal B.coli	.....	.....	99.5

TABLE II — OPERATING DATA OF PEORIA SLUDGE-DIGESTION. AUGUST TO DECEMBER, 1931

Solids added to digestion tanks No. 1 and 2, lb.	2,930,000
Digested sludge to drying beds, lb.	1,600,000
Digested sludge in digester No. 3, lb.	350,000
Total gas production, cu.ft.	15,096,700
Per cent reduction of solids	33
Per cent reduction of volatile matter	55
Gas per pound of volatile matter added, cu.ft.	8.8
Gas per unit population equivalent, cu.ft.	0.9
Sludge removed from beds (50 per cent H_2O), tons	1,280

Engineering Literature

A Monthly Review of Books and a Listing of New Publications

Small Highway Bridges

REVIEWED BY A. B. COHEN
Consulting Engineer, New York City

HIGHWAY BRIDGES: Design and Cost—By John Edward Kirkham, Research Professor, Civil Engineering, Oklahoma Agricultural and Mechanical College; Consulting Engineer. Formerly Designing Engineer, American Bridge Co.; Professor of Structural Engineering, Iowa State College; Consulting Bridge Engineer, Iowa Highway Commission, South Dakota Highway Commission. New York and London: McGraw-Hill Book Co. Inc. Cloth; 6x9 in.; pp. 395; line cuts and tables. $4.

PROF. KIRKHAM'S book deals with the essentials governing the design of small highway bridges of either reinforced concrete or structural steel suitable to the flat country of the Middle West. No attempt has been made to treat the more complicated problems of the arch bridge with its many ramifications and variables involved with construction details, drainage of floors and provisions for temperature changes, or the movable steel bridge with its fine balancing of parts and machinery adjustments.

Small bridges are simply and thoroughly analyzed, step by step, in theory, and the application thereof is made to specific bridge dimensions and loadings in determination of the required sections. For the reinforced-concrete bridge these sections include the slab or rectangular cross-section, the T-beam deck girder and the through girder type. The theory here is a repetition of accepted practice but bears repetition in combination with the effectual arrangement for the student and the beginner of the numerical solutions of each case. The structural steel bridges analyzed include the simple I-beam floor with wooden or concrete deck slab, plate girder of 60-ft. span and various types of through truss bridges of 50- to 100-ft. spans. There are a number of reproductions of detailed drawings of standard state highway truss bridges which properly supplement the examples developed.

The problem of determining the amount of distribution of concentrated wheel loads over concrete floor slabs reinforced in one or two directions, and over a series of either steel or concrete floor beams, that perplexes most beginners, has been lucidly solved and applied by the author in his numerous examples. Research work in this fundamental, spread over the past fifteen years, and the application of the findings, as made by the author, have considerably improved the character and effectiveness of concrete bridge design.

The scope of the chapter on foundation could well have been increased. As it stands the discussion is confined to the design of several types of reinforced-concrete abutments and a solid or gravity pier with some reference to pile design. A chapter or two on construction problems might have been included with profit. The general impression gleaned from a perusal of this book is that the author in restricting his endeavor to a limited field of design for the beginner covered it in an unusually thorough and interesting manner.

Many Pathways but One Goal

PATHWAYS BACK TO PROSPERITY: A Study of Defects in Our Social Machine and How to Mend Them—By Charles Whiting Baker, C.E. New York and London: Funk & Wagnalls Co. Cloth; 6x8 in.; pp. 351; $2.50.

MUCH of Mr. Baker's "Pathways Back to Prosperity" is devoted to the causes that led to the present economic depression. Chief among these causes, as he and many others see them, are the production of goods by the aid of power and the perfection of machinery at a far greater rate than means have been provided for their distribution to and purchase by consumers. In fact the case is far worse, for the efficiency of production and attempts to utilize for further profit the capital it has piled up have led to still more production, and the displacement of men by machines has thrown men out of work and thus lessened purchasing power. One of the pathways back to prosperity is to lessen technological unemployment by shorter working hours and weeks and to increase purchasing power still further by giving power and machine tenders a larger percentage of the wealth they and the machines produce. The author does not overlook the difficulties which this plan presents.

Among other depression alleviations that are discussed by Mr. Baker, in the lucid and convincing way that will be remembered by readers of *Engineering News* in the long years of his editorship of the journal, are the decentralization of industry and population, including a "return to the land"; higher wages where reasonably possible; improvement of our banking system so "that the ideal of trusteeship for service of the public shall be uppermost and that participation in commercial activities by the banks in order to earn larger profits shall be abandoned"; substitution of economy for extravagance; reduction of debts, "domestic and international"; solution of gold standard problems; and unemployment insurance. Above all these, just now, is the restoration of confidence in business and finance, toward which Mr. Baker believes the various pathways he suggests would lead.

In pointing out so many causes and contributory remedies for depression as Mr. Baker does he can hardly expect that his discussion will meet with universal approval, but it seems likely to come nearer doing so than many of the other stimulating books on the subject. For our part, mention will be made of only one line of reasoning which Mr. Baker carried much too far. He says that the era of construction has passed and has given place to an era of production. While this is true in the particular on which he lays most stress, railway construction, there remain many other industrial wants that can be satisfied only by vast expenditures for construction. Notable among these is the building and improvement of highways to carry the motor vehicles that have escaped the railways. In addition, our cities, towns, villages and crossroad hamlets are far from adequately provided with paving, proper water supply, adequate means for the disposal of garbage and other refuse, to say nothing of good housing at reasonable cost for millions of people, and recreation facilities for these and other millions that this machine age has provided with leisure scarcely dreamed of until within a few years. These and other construction needs have been in the minds of those who have recently urged public works and housing construction ranging from the half-million dollar outline of a committee of the American Water Works Association, headed by Malcolm W. Pirnie, in behalf of a single utility to the stupendous total of twenty billions for public works and the modernization of buildings and plants outlined only a few days ago by Francis Lee Stuart, president of the American Society of Civil Engineers, in a statement issued by the American Engineering Council. (*ENR*, April 14, p. 563.)

The Ugly Duckling Iota

ELEMENTARY HYPERBOLICS for Technical and Other Students, Specially Adapted to the Requirements of Beginners—By M. E. J. Gheury De Bray. Author of "Exponentials Made Easy." Vol. I, Hyperbolic Functions of Real and Unreal Angles; Vol. II, The Application of Hyperbolic Functions. London: Crosby Lockwood & Son. Cloth; 5x8 in.; pp. 351; line cuts and tables. 7½s. per volume.

MR. DE BRAY says on the dust wrapper of his book: "This Treatise leads the reader by easy stages to a clear and complete understanding of the hyperbolic functions and of their principal applications to Geography, the

solution of Simple and Differential Equations, Engineering, Strength of Materials, and Electricity." Some examples of how the author lures on the student, taken from the contents, are: "On Somersaults"; "Where We Meet Again With an Old Acquaintance, and, With Its Help, Venture Into a Maze and Discover a Treasure"; "How Sinh and Cosh Help the Geographer and Navigator"; and "The Apotheosis of the Ugly Duckling Iota."

Light, Power and the Public

POWER ETHICS: An Analysis of the Activities of the Public Utilities in the United States, Based on a Study of the U. S. Federal Trade Commission Records —By Jack Levin, Research Staff, People's Legislative Service, Washington D. C. Introduction by Dr. John H. Gray, Head of the Department of Economics; Graduate School of the American University, Past-President of the American Economic Association, Former Chief Analyst and Examiner, Interstate Commerce Commission, Bureau of Valuation. New York: Alfred A. Knopf. Cloth; 5x8 in.; pp. 191. $2.

THE PUBLIC PAYS: A Study of Power Propaganda — By Ernest Gruening, Author of "Mexico and Its Heritage." New York: The Vanguard Press. Cloth; 6x9 in.; pp. 273; $2.50; or not bound, $2.

POWER AND THE PUBLIC—Edited by Ernest Minor Patterson, Ph.D., Professor of Economics, University of Pennsylvania; President of the American Academy of Political and Social Science. Philadelphia: The American Academy of Political and Social Science, 3457 Walnut St. Cloth; 6x9 in.; pp. 189. $2.50 or, in paper covers, $2.

THE vast mass of testimony before the Federal Trade Commission on propaganda by the power and lighting utilities, or at least the parts of it which two diligent workers think "show up" the utilities, has been digested by Jack Levin in "Power Ethics" and by Ernest Gruening in "The Public Pays." The results deserve wide reading, particularly by the general public, which ought to be informed of the nature and extent of this propaganda, put out year by year at great cost by a large, diversified and well-generaled army drawn not only from the leaders among the utilities but also from hosts of men and women in various walks of life—some unsuspecting but many well knowing that they were being employed to bemuse the public.

The method of each book is to let the utility men and their mouthpieces condemn themselves by their own words: Mr. Gruening, by citations of fair length; Mr. Levin, quite generally by paraphrases in which a few words are set in quotation marks. Mr. Gruening's quotations generally run to sufficient length to give at least the spirit of the original speaker or writer; Mr. Levin cites chapter and verse by reference to the testimony, but while theoretically this enables any who wish to go to the twenty-odd volumes of testimony for verification, few readers can do so readily and most not at all. The smaller book will appeal to many for its brevity and will enable any reader to judge for himself of the character of power ethics.

Even those who followed for a few days the press reports of the testimony digested in these books will be surprised, now that it is presented in a classified summary, to learn how well organized, long continued and successful in some of its main objects were the efforts of the National Electric Light Association and other national utility organizations in getting the support not merely of city school instructors and college professors but also of the colleges themselves in becoming sponsors for the utilities and opponents of municipal ownership. Not only that: authors and publishers of textbooks made revisions and eliminations of statements objectionable to the light and power companies. Perhaps the most surprising of all was the publication by the Smithsonian Institution of a "research" study attacking the Ontario hydro-electric project.

Failure to discriminate between publicity designed to promote sales and that intended to mislead the public is a weakness and unfairness of Mr. Gruening's book. This is notable in some of the excerpts and comments relating to work among women and children.

Pro and con

In contrast with two volumes just noticed is "Power and the Public," a symposium of nineteen papers in six groups presented last November before the American Academy of Political and Social Science. As usual in the many notable symposia of the institution named, both sides of the question, when there are two strongly contrasting sides, are represented. Thus, on holding companies, their "evils" are strikingly set forth by Dr. James C. Bonbright, of Columbia University, and objections to "pyramiding" are well put by John T. Flynn, author of "Graft in Business" (*ENR*, Nov. 19, 1931, p. 821), while an able and moderately put "defense" is made by William H. Hodge, vice-president and manager of the Byllesby Engineering and Management Corp. There are five papers, pro and con, on "Rates —Domestic, Commercial and Power," with Henry T. Hunt, ex-mayor of Cincinnati, dealing thoughtfully with "Lower Domestic Rates." Of the two papers on "Regulation," Gifford Pinchot argues for federal and William J. Donovan for state regulation.

Outstanding among the group of four papers on "Regulation" is "The Control of Power Rates in the United States and England," which will bring new facts to many readers both sides the Atlantic. The author, Richard Joyce Smith, assistant professor of law at Yale University, recently spent a year in England studying "legislative control of electrity supply" there. Additional British data are given in the group of papers on "Public or Private Ownership." Here "Ownership and Regulation of Electric Utilities in Great Britain" is reviewed by Dr. Orren C. Hormell, of Bowdoin College. In this same group Joseph B. Eastman, member of the Interstate Commerce Commission since 1919, sets up "A Plan for Public Ownership and Operation" and Samuel Ferguson, president of the Hartford (Conn.) Electric Co., takes a moderate stand in "A Defense of Private Ownership."

"Our Electric Future" is the concluding topic of the symposium. Here there are two able essays: "Electricity, Mankind's Universal Servant," by M. S. Sloan, former president of the New York Edison Co., and "The Future of Power and the Public," by Donald H. Richberg, a member of the Chicago bar "who has specialized in public utility and labor law."

Land and Floating Cranes

MÉCANIQUE ÉLECTRICITÉ ET CONSTRUCTION: Appliquées aux Appareils de Levage—Tome III: Les Grues Terrestres et Flottantes, leur Stabilité par leur Poids Propre. Par Louis Rousselet, Ingénieur des Arts et Métiers Ancien Chef de Service d'Appareils de Levage. Paris: Donod, 92 Rue Bonaparte (VI). Paper; 8x11 in.; pp. 590; 448 illustrations, mostly line cuts. 210 fr.; bound, 223 fr.

FACTORS entering into the stability of land cranes and floating cranes are the subject of this, the third of a series of books on lifting machinery. The two previous volumes covered traveling cranes (1921) and traveling and gantry cranes (1929). Both fixed and movable revolving cranes of various types are covered, also the large gantry crane so commonly used for port work in Europe, and various types of floating cranes. Elaborate mathematical discussions of the factors involved in determining the stability of cranes are given, as are the principal elements entering into the design of the cranes and crane booms. The stability of pontoons is discussed at length in the section devoted to floating cranes. The book is copiously illustrated with diagrams of cranes, including graphical solutions of the static problems involved in boom and gantry framework design.

Small Cities Can Save

PURCHASING FOR SMALL CITIES—By Russell Forbes. Publication No. 25. Paper; 7x10 in.; pp. 18; 25c. from Municipal Administration Service, 261 Broadway, New York City.

IN THESE DAYS of urgent need for every reasonable saving in municipal expenditures Mr. Forbes' concise summary of the advantages of centralized buying of supplies for small cities should be most welcome and useful. The practice has more than justified itself for some of the larger cities and for a number of states. Naturally, it needs to be modified for cities of less than 25,000. How this may be done is set forth by Mr. Forbes, a recognized authority on centralized purchasing. The possibilities of cities clubbing together for purchasing supplies is men-

tioned at the close of the pamphlet, with a citation of cooperative buying by the Michigan Municipal League. Worthy of note is the fact that a considerable percentage of the smaller cities under the manager plan practice centralized purchasing—by a special officer, or by the city engineer, or by some other official who gives only a part of his time to the work. The 10 per cent saving that the author believes can be made by centralized buying is doubly desirable in these days of crippled municipal finances.

Municipal Retrenchment

HOW AMERICAN CITIES ARE RETRENCHING in Time of Depression—By Harry H. Freeman, Buffalo Municipal Research Bureau. Supplement to April number of *National Municipal Review*, 34th St. at Second Ave., New York City. Paper; 6x9 in.; pp. 16. 25c. for the supplement only.

REDUCING MUNICIPAL EXPENDITURES: Data from city officials in April issue of *Public Management*, 923 East 60th St., Chicago. 50c. a copy.

TWENTY-SIX of the largest cities of the United States are covered in Mr. Freeman's pamphlet. His data (he undertakes no critical comment) were gathered in the course of work by the Buffalo Municipal Research Bureau to aid Buffalo in framing a "retrenchment policy." Ten of the 26 cities were "intensively studied" on the spot by members of the bureau's staff. Data for the other cities resulted from a questionnaire sent out by J. M. Leonard, of the Detroit Bureau of Governmental Research. All the data are drawn largely from 1931 or 1932 budgets or from budget proposals or other programs now pending.

Most of the cities considered have cut expenditures for the year covered, compared with the previous year, but decreased revenues sometimes offset or more than offset the cuts. The most general way of expense cutting has been in payrolls, including direct slashes of 3 to 25 per cent, postponement of scheduled increases, five-day weeks and payless vacations. Curtailment or cessation of public improvements, even those assessed on abutting property, together with reductions in the amount of service rendered, such as street cleaning and garbage or refuse removal, are common, as also abandonment of band concerts and other commendable but more vital services.

The 37 cities reported on in *Public Management* are much smaller than those included in the Freeman pamphlet. Some are quite small. A few report spending at least a little more money and giving more service than in earlier years, but reduction of expenses in general—along the same general lines as in the large cities.

As a rule, the reports from the cities included in the two surveys show creditable efforts to meet trying conditions, often with great sacrifices of pay to city servants and of service to citizens. The individual reports are well worth the study of officials in other cities and all others who are or should be concerned with the financial plight of our cities and how it fits into the picture of these years of depression. Those who wish to pursue this subject farther will find reports from many cities on "Salary Reductions in the Municipal Service" in *Public Management* for March, while in the same journal for December, 1931, there are reports from a number of city officials on "Retrenchment in Municipal Expenditure." Still more comprehensive is the bulletin of late 1931 on "The Present Financial Status of 135 Cities in the United States and Canada," published by the Municipal Administrative Service, 26 Broadway, New York City. (See *Engineering News-Record*, Dec. 17, 1931, p. 977.)

Roads of Fifty Centuries

THE STORY OF THE ROAD from the Beginning Down to A.D.1931—By J. W. Gregory, F.R.S., LL.D., D.Sc. Emeritus Professor of Geology at the University of Glasgow. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 311; 4 maps and 30 halftones. $4.

THE elephant, the rhinoceros, the antelope and the buffalo come within the scope of Dr. Gregory's interesting and comprehensive review of the history of the road through the centuries. Even the boa constrictor is not overlooked, for it "tunnels through the undergrowth of South American forests" as it glides "to the rivers for water or to capture the small animals that go there to drink." These "game tracks" were found useful to man as he became migratory. Later on came the great prehistoric trade routes over long distances, like those for amber and lapis lazuli centuries before the Christian era; still later, there was the great silk trade from China to the Mediterranean countries. After briefly sketching all these the author takes up ancient British roads, deals with "The Pioneers in Road-Making — the Egyptians and Carthaginians," the Roman road, both in general and in Britain, middle-age English roads, roads of China and of Peru.

After having disposed of ancient and medieval roads Dr. Gregory breaks into the historic continuity of his story with chapters on "The Principles of Road Construction and Road Materials," the least satisfactory of any in the book. They are followed by a pertinent chapter on vehicles and their influence on roads and a chapter on "The Political Evolution of the Road," which deals particularly with British legislation and administrative control.

The historical thread, as regards the road itself, is then picked up again, with striking comments by the author and apt quotations from contemporary writers on the deplorable condition of most British roads in the seventeenth and well down into the eighteenth century. Due attention is given to the military roads in the Scotch Highlands, built by Gen. Wade early in the eighteenth century. After passing references to the forward-looking essay by Phillips, to the work of Tresaguet in France and his follower in England, John Metcalf, "the blind road contractor of Knarlsborough in Yorkshire," there come interesting pages on Telford and Macadam, with a summary of the attempts of followers of Telford to belittle Macadam's roads.

In the chapter on the "Modern Motor Road" the author again gets beyond his depth in some parts of his discussion of road design and construction. Aside from a few pages on "The Future of the Road," the book closes with remarks on Napoleon's roads in the Alps, and notes on the roads of France, Germany, Italy, the United States and India.

With few exceptions the various chapters of the book are prefaced by quotations from the poets that add to the literary interest of a book which should have a broad appeal to engineers and contractors.

Mason Revised by Buswell

EXAMINATION OF WATER: Chemical and Bacteriological—By William P. Mason, Professor Emeritus of Chemistry, Rensselaer Polytechnic Institute. Sixth Edition, Revised by Arthur M. Buswell, Professor of Chemistry, University of Illinois; Chief, Illinois State Water Survey. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 224. $3.

SINCE the first appearance of Prof. Mason's textbook on water analysis more than 30 years ago the original volume and its several revisions have been the guide of hundreds of students. Meanwhile the genial and versatile author has found a warm place in the hearts of his students and of the waterworks fraternity.

In the fifteen years since the appearance of the fifth edition there have been many changes in the practice and the terminology of water examination. These have been taken into account by Dr. Buswell in his revision for the present edition. He states in his preface that he has aimed "to preserve as far as possible the spirit of the original work," bearing in mind "the historical background" which Prof. Mason "was able to furnish from his own rich experience." Notable among the new features of this edition are methods for determining both pH and free chlorine. The mineral contents of water, softening, coagulation and chlorination are given more attention than formerly. The U. S. Public Health Service Standards for drinking water supplied by interstate carriers and the analytical methods of the American Railway Association have been added.

Those who are concerned with the bacterial examination of water should be forewarned that the book contains

only a few pages on that subject, a fact easily justifiable but hardly to be expected from the sub-title, which gives equal weight to both these objects of water examination.

Thermal Gradient of Water in Concrete and Metal Conduits

REVIEWED BY EUGENE KALMAN
Professor at the University of Milan, Italy; now in New York City.

IL RISCALDAMENTO DELL'ACQUA NELLE CONDOTTE—By Giulio Supino, Professor at the Engineering School of Bologna, Italy. Bologna: Nicola Zanichelli. Paper; 7x10 in.; pp. 35; 3 linecuts. 8 lire in Italy.

PROF. SUPINO in his Italian monograph "Il Riscaldamento dell'Acqua Nelle Condotte" develops new formulas for the thermal gradient of water in metal and concrete conduits.

The classic formula of Forcheimer, based on stationary thermal conditions, implies a certain error due to the fact that in reality the thermal gradient depends on the oscillatory fluctuation of temperature in the soil. An experimental check of the formula of Forchheimer would require systematic observations on a large number of conduits laid at various depths in different kinds of soils. In lack of data to warrant such a procedure, the only way to secure better insight into the thermal conditions in conduits is a more penetrating theoretical analysis. This is the method followed by the author. By means of successive approximations by Besselian functions he derives a new formula in which the oscillatory part of the temperature appears in its due importance.

As an additional result of his investigation, the author derives an independent formula for conduits of concrete or masonry having a low thermal conductivity and considerable thickness —conditions quite different from those prevailing in metal conduits.

Bobbin Boy to Steel Magnate

INCREDIBLE CARNEGIE: The Life of Andrew Carnegie (1835-1919)—By John K. Winkler, Author of Morgan the Magnificent, etc. New York: The Vanguard Press. Cloth; 6x9 in.; pp. 307; illustrations. $3.50.

FROM a five shillings a week bobbin boy of twelve in a cotton mill in Allegheny, Pa., a few years after his arrival with his parents from Dunfermline, Scotland, through his marvelous career as telegraph messenger, railway operating official, steel maker, supermillionaire, philanthropist, author, host of famous men and women at Skibo Castle to his death past fourscore at his Lenox estate, Mr. Winkler's "Incredible Carnegie" lives up to the title he has chosen for his biography.

Entertaining throughout, the book is not entirely pleasant reading, because the author deals frankly with Carnegie's ruthless way of attaining his ambition for wealth and power, even at the sacrifice of some of the lieutenants of industry he had such a flair for choosing. There is also a similar but not so marked an unpleasantness in Mr. Winkler's portrayal of Carnegie's benefactions, which, the author urges, were largely made for self-glorification.

Carnegie's "young men" are given much attention, particularly Frick, and, as the author tells it, Carnegie's growing jealousy and final riddance of the man. Frick and the Homestead strike are graphically portrayed, with quotations from Carnegie's messages from Scotland urging Frick on—which the author holds up as wholly out of keeping with Carnegie's many words for workmen and unions in his previous warm-hearted exuberances.

The interest of the book is broadened and heightened by occasional references to John D. Rockefeller and J. Pierpont Morgan, each of whom has been the subject of a biography by Mr. Winkler: "John D., A Portrait in Oils," and "Morgan the Magnificent."

Publications Received

ELIMINATION OF GROUND CONTROL in photographic mapping is the subject of a paper by Earl Church, associate professor of photogrammetry, at Syracuse University, Syracuse, N. Y., which has been published by the university. The paper is the fifth of a series of papers on topographic mapping by aerial photography. Copies may be obtained upon application to the university.

TERMITE EXPOSURE TESTS being carried out by the Forest Service, U. S. department of agriculture, were the subject of a third progress report presented at the 28th annual meeting of the American Wood Preservers Association in January. For the convenience of those interested, the report has been printed in a separate pamphlet by the American Wood Preservers Asscoiation, 228 North LaSalle St., Chicago, Ill.

A DIRECTORY OF CONTRACTORS has been published by the Bureau of Contract Information, Inc., 729 Fifteenth St., N.W., Washington, D. C. The directory includes the names of all contracting firms throughout the United States who have filed their performance records with the bureau. Copies of this directory, according to the bureau, are "available to those legitimately entitled to them, at $5 per directory."

AN INDEX OF AMERICAN ENGINEERS and engineering firms, including a list of paving contractors in a few of the larger cities, the addresses of state highway departments and of the division officers of the Corps of Engineers, also a list of American engineering firms operating abroad, is published by William Stack, Box 203, Park Ridge, Ill. The listing of engineers includes only those listed in the Red Book of the cities covered, and consequently is not complete. The price is $1.50.

WASHINGTON AS ENGINEER and City Builder is the subject of Pamphlet No. 13, one of a series published by the George Washington Bicentennial Commission, Washington Building, Washington, D. C. The pamphlet is one of a group published by the commission to honor George Washington. It was prepared by Lieut. Col. U. S. Grant, 3d, U. S. A., and includes extensive quotations from the writings of George Washington which relate to engineering and city planning matters, also copies of his sketches and maps. Copies may be obtained free of charge from the commission.

THUMB NAIL SKETCHES to show the exact location of benchmarks is an interesting if not unique feature of "Livellazioni di Precisione per il Rilievo Altimetrico dei Corsi D'Acqua" (Precise Levels for Height Determinations of Watercourses), one of a series of official publications on the hydrography of the River Po being brought out by the ministry of public works, Parma, Italy. The right half of each page contains three sketches, each showing a bridge, building, wayside cross or other structure with the exact location upon it of marks for the elevation and distance. On the left hand part of the page are printed in columns the station number, description of the structure on which the benchmark has been placed, and the horizontal and vertical locations of the marks.

New Books and Revised Editions

[*Those desiring copies of the books listed below or mentioned elsewhere in this section should order them from the publishers or from their local booksellers.*]

AMERICA FACES THE FUTURE—Edited by Charles A. Beard, Co-author of "The Rise of American Civilization" and "The American Leviathan"; sometime President of the American Political Science Association. Boston and New York: Houghton Mifflin Co. Cloth; 5x8 in.; pp. 410. $3.

A BASIS FOR STABILITY—By Samuel Crowther, in collaboration with Myron C. Taylor, Alfred P. Sloan, Jr., Henry Ford, John Hays Hammond and seventeen others. Boston: Little, Brown & Co. Cloth; 6x9 in.; pp. 360. $3.

BUILDING PERMITS IN THE PRINCIPAL CITIES OF THE UNITED STATES IN 1930. Bureau of Labor Statistics Bulletin No. 545—Paper; 6x9 in.; pp. 94; tables. 20c. from Superintendent of Documents, Washington, D. C.

BUSINESS LOOKS AT THE UNFORESEEN—By Wallace Brett Donham, Dean, Graduate School of Administration, Harvard University, New York: Whittlesey House, McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 209. $2.50.

CONVERSION FACTORS FOR ENGINEERS: A Compendium of Useful Data for the Rapid Conversion of the Common Engineering Units of Measure of One System Into the Different But Related Units of Another System—New York: The Dorr Co., Engineers, 247 Park Ave. Paper; 8x11 in.; pp. 5. Free on application.

ELECTRICAL EQUIPMENT ON MOVABLE BRIDGES—By Condé B. McCullough, Bridge Engineer, Oregon State Highway Department, Albin L. Gemeny, Senior Structural Engineer, Division of Tests, Bureau of Public Roads, and W. R. Wickerham, Electrical Engineer. Technical Bulletin 265 (October, 1931), U. S. Department of Agriculture—Paper; 6x9 in.; pp. 114; halftones and diagrams. 35c. from Superintendent of Documents, Washington, D. C.

Monograph on the subject indicated.

ECONOMIC ASPECTS OF A SALT WATER BARRIER Below Confluence of Sacramento and San Joaquin Rivers: Reports on State Water Plan—Prepared under direction of A. D. Edmonston, Deputy State Engineer, by Raymond Matthew, Hydraulic Engineer. Sacramento, Calif.: Division of Water Resources, California Department of Public

Works, Edward Hyatt, State Engineer. Paper; 6x9 in.; pp. 450; folding plates.

Report on the advantages and practicability of constructing a barrier to prevent "the annually recurring upstream movement of salt water from the ocean into the channels of upper San Francisco Bay and the Sacramento-San Joaquin Delta, and thereby creating and maintaining a fresh-water lake from which water supplies now available or hereafter made available from the Sacramento and San Joaquin rivers might be utilized by industries, municipalities and agricultural developments in the upper bay and delta regions."

FREILEITUNGSBAU MIT SCHLEUDERBETONMASTEN—Von Dr.-Ing. Ludwig Heuser und Ober-Ing. Robert Burget. Munich and Berlin, Germany: R. Oldenbourg. Paper; 7x10 in.; pp. 176; 148 line cuts and halftones. 10 marks.

Detailed descriptions of the design and manufacture of patented spun concrete poles for electric transmission lines, as carried out by the proprietors. Within the limits indicated the publication is a valuable monograph. It is well illustrated and goes briefly into the mathematics of the subject.

HISTORY AND ENGINEERING OF Rochester's Water Supply in Its First Century—By Edwin A. Fisher. Vol. 7, No. 3 (March, 1932) Rochester Academy of Science. Paper; 7x10 in.; pp. 95; illustrated. $1.

Authoritative sketch. The author was principal assistant engineer on construction of additional water supply, 1893-96; city engineer, 1896-1914; city consulting engineer, 1914-27, retired, and in those capacities was in close touch of the works described.

IT WON'T LAST: A Message for the Times—By Orison Swett Marden, Author of "Peace, Power, and Plenty." New York: Thomas Y. Crowell Co. Cloth; 5x8 in.; pp. 60. $1.

Reprinted from the author's "The Conquest of Worry."

MANUAL OF ELECTRIC ARC WELDING—E. H. Hubert, M.A.I.E.E., Editor, formerly Assistant Editor of *Industrial Engineer* and *Electrical World*. New York and London: McGraw-Hill Book Co. Cloth; 6x9 in.; pp. 163; halftones, diagrams and tables. $2.

PRINCIPLES OF PUBLIC UTILITIES—By Eliot Jones, Ph.D., Professor of Economics in Stanford University, Author of "Principles of Railway Transportation," and Truman C. Bigham, Ph.D., Professor of Economics in the University of Florida. New York: The Macmillan Co. Cloth; 6x9 in.; pp. 799. $6.

THE PUBLIC PAPERS OF FRANCIS G. NEWLANDS—Edited and Placed in Historical Setting by Arthur B. Darling, Associate Professor of History in Yale University. Two volumes. Boston and New York: Houghton Mifflin Co. Cloth; 6x9 in.; pp. 434 and 426. $10.

RESEARCH IN FARM STRUCTURES—By Henry Giese, Senior Agricultural Engineer, Bureau of Agricultural Engineering. Paper; 6x9 in.; pp. 52; maps and diagrams. 15c. from Superintendent of Documents, Washington, D. C.

STEAM POWER STATIONS: Equipment and Maintenance—By G. O. McLean, M.Eng. (Liverpool), A.M.I.E.E. London: Crosby Lockwood & Son. Cloth; 5x7 in.; pp. 106; line cuts and tables. 7/6 net.

Deals in an elementary way with steam stations, "more especially large three-phase installations for the supply of electrical energy to towns and large industrial areas."

STONE & WEBSTER: A Brief Account of the History of This Organization and of the Services Developed During 44 Years. Cloth; 6x9 in.; pp. 26; sketches. Free on application.

SYMPOSIUM ON WEATHERING CHARACTERISTICS OF MASONRY MATERIALS: Held at the 34th Annual Meeting of the American Society for Testing Materials, June, 1931. Paper; 6x9 in.; pp. 128; halftones and tables. 60c. from American Society for Testing Materials, Philadelphia, Pa.

Takes up masonry, concrete, structural clay, natural clay products, slate, aggregates; test procedures for concrete, clay and stone; has bibliography and abstracts.

A TEXT-BOOK ON ROOFS AND BRIDGES: Part II, Graphic Statics—By the Late Mansfield Merriman, M.Am.Soc.C.E., and Henry S. Jacoby, Professor Emeritus of Bridge Engineering, Cornell University. Revised by Everett E. Ebling, Assoc.M.Am.Soc.C.E. Fifth Edition, Revised and Rewritten. New York: John Wiley & Sons, Inc. London: Chapman & Hall, Ltd. Cloth; 6x9 in.; pp. 228; photographs, line cuts and tables. $3.25.

The first edition of this time-honored book appeared in 1890. The fourth edition was reviewed in detail in *ENR* Sept. 30, 1917, p. 560. The present edition has been brought up to date in illustrative matter. Somewhat more emphasis is placed upon highway trusses than in former editions. New material comprises an article on the transverse bent and another on viaduct towers. Revision has reduced the pages in the book about 25 per cent.

TRANSFORMATEURS DE MESURE ET RELAIS DE PROTECTION—By Charles Bresson, Ingénieur en chef aux Ateliers de Delle. Paris: Dunod, 92 Rue Bonaparte. Paper; 7x10 in.; pp. 293; halftones and diagrams. 82 fr.

DER ZWEISTIELIGE STOCKWERKRAHMEN—Von Dipl.-Ing. E. Elwitz, Beratender Ingenieur in Düsseldorf. Düsseldorf, Germany: A. Bagel A.-G. Paper; 7x11 in.; pp. 40; diagrams and tables.

Letters to the Editor

Labor Can Help Revive Business

Sir—I quote from the editorial "Enlightening Testimony" in your issue of March 17:

> Non-competitive and non-productive improvement work is the sole means of bringing about the increased employment on which the cycle of industrial activity is capable of being built up. And with slight change of statement this same relationship holds in times of normal activity, for the constant flow of surplus production into increased productive capacity must inevitably lead to economic unbalance and collapse unless prevented by the diversion of most of the surplus into public works.

If the work must be non-competitive and non-productive, why may not the same end be attained through charitable relief? The improved morale and the return for expenditure are worth while, but I am asking about the economic effect on unemployment. If your reasoning is correct, would not the sums expended for charity and for soldiers' bonuses have done what you believe would be accomplished by stimulated public work? May there not be this objection to your plan, that it tends to give employment to the highly organized building trades, who very properly raise wages in prosperity but who very improperly resist wage reductions in depression and who now stand in the way of resumption of building construction because of excessive cost? To stimuate their employment on public work would tend to prevent resumption of private employment, particularly in the building industry.

I also question your statement that the constant flow of surplus production into increased productive capacity must lead to collapse. It is that constant flow that prevents collapse. It is when the flow is interrupted and is no longer constant that unbalance occurs.

We are operating under an economic plan more definite than that of Russia, and we are having the advantage of automatic operation. Profit is the automatic control. The plan is to increase production of commodities faster than population. There results more to divide, and as a consequence wages and incomes tend to rise. Wages have been increasing for centuries relative to prices. When wages rise, the demand for labor exceeds the supply and jobs are available for all.

Security of employment is incompatible with progress. Attempts at stabilization upset the normal upward trend of production, which was about 4 per cent in 1929. We did not have overproduction then, but underproduction instead, as was evidenced by increased prices. We do not have overproduction now, but merely an illusion of overproduction because of reduced demand. Let labor help to reduce the price of finished products to more favorable relation to that of raw materials, and business will revive. DANIEL B. LUTEN.

Indianapolis, Ind.,
March 31, 1932.

Labor's Share of Relief Funds

Sir—In your issue of March 24, p. 445, I find an answer to my statement of conditions in Chicopee, Mass., which sounds like an opinion from an economist in Lehigh University.

Like Grover Cleveland in 1893, inheriting hard times after the Harrison administration, Chicopee is confronted with a condition, not a theory. For a hundred years Chicopee's products were of the highest grade and known from Podunk to Hong-Hong. Its textiles, machine tools, bronzes, bicycles, rifles, automobiles and agricultural tools were managed by men of high business and inventive acumen. More recently, sporting goods and tires have been most prominent. We have seen a number of these splendid concerns wax and wane and have felt the result of constant urge to make machinery more and more automatic.

In regard to our $800,000 expenditures of last year—by the way, exceedingly large for us—of three-eighths spent by the city our labor profited about 50 per cent. Of five-eighths expended through three contracting firms our unemployed received less than 5 per cent; hence my expressed disappointment.

Massachusetts requirements of labor insurance also give point to Dr. Osler's famous dictum that "A man more than 40 ought to be drugged."

You will pardon me for trenching on your patience, but the philosophic ideas of my friend from Bethlehem spread over two and one-half columns of your valuable space failed to touch our case.

Chicopee, Mass.,
March 30, 1932.

F. O. COBB,
City Engineer.

NEWS OF THE WEEK

Bonds for Pay of Hetch Hetchy Workers Sold to Advantage

The second month's sale of Hetch Hetchy bonds by the Hetch Hetchy Bond Purchase Syndicate, San Francisco, which consists of the 1,400 men employed in the construction of the Coast Range tunnel of the Hetch Hetchy system, sold at a discount of only 2.71 per cent. Bonds with a par value of $221,000 were sold for $215,015 to pay the March salaries of the men. This shows a decided improvement over the results of the last month sale at a 4.45 per cent discount, which was the first sale of bonds under the new payment plan put into effect by the city of San Francisco to employees on the Hetch Hetchy system.

U. S. Supreme Court Not to Review Ohio Special Assessment

Validity of the Ohio sewer district law would seem to be definitely and finally established following a refusal of the U. S. supreme court on April 14 to review the case of Bowman vs. Commissioners and Auditor of Allen County, which brought into question the constitutionality of guarantee by a political subdivision of bonds issued in anticipation of the collection of special assessments. The Ohio supreme court had rendered two decisions in this case, the first denying the constitutionality of this procedure and the second reversing the first decision and upholding the law and requiring Allen County to levy a general tax for the payment of principal and interest on defaulted sewer district bonds. (See *ENR*, June 25, 1931, p. 1065.)

In a brief filed by Attorney General Bettman in support of the lower court's ruling it is stated that similar bonds in the aggregate amount of more than $50,000,000 have been issued by other counties under the statutes which were challenged.

Colorado Engineers Raise Relief Funds

The Colorado Engineering Council, Denver, Colo., has started a campaign to raise funds among Denver engineers to provide relief for unemployed members of that profession. Engineers are asked to subscribe at least one day's pay a month for this fund.

A similar drive last fall raised sufficient funds to provide partial employment for 176 engineers.

Bids for Bank-Protection Work on Mississippi Asked

The Memphis engineer's office is asking bids for construction of 15 miles of bank-protection work in the district on the Mississippi River from Cairo, Ill., to the mouth of the White River in Arkansas. Hitherto this work has been conducted entirely by government engineers. The call for bids from contractors is a test to see whether Southern contractors are interested in so large a project. The bids call for construction and placing of either concrete or willow mattresses and paving on the water slopes with concrete, concrete mattresses or riprap stone. The award of the contract is contingent on the appropriation of funds, and bidders will not be held to their bids if contracts are not awarded within 60 days after the date of opening. If the contract is awarded, work will start about June 1 and must be completed by Dec. 1.

Unemployment Aid Given by Cleveland Engineers

Considerable progress in uncovering new engineering jobs and industrial jobs of an engineering character is being made by a group of investigators working under the auspices of the Cleveland Engineering Society. Twenty unemployed engineers are making plant-to-plant visits in the Cleveland area, consulting with plant executives on possibilities of improving business through improvement of product, plant and methods, the more extensive use of research, analyses of markets, the use of the Cleveland Engineering Society employment service, and a closer cooperation among banks, industrials and engineering organizations.

A number of new jobs have been found, but the ratio of applicants to jobs available still remains high.

Personnel and Salary Cuts in Kansas Highway Department

One of the first official acts of the newly reorganized Kansas state highway commission, which met for the first time on April 11, was to decrease personnel and order salary cuts of 10 per cent, or $221,000 a year. The office of assistant highway director, created a year ago and held by R. W. Dole at a salary of $4,800, was abolished, as were more than a score of other offices. Personnel reductions go into effect May 1 and salary cuts will become effective July 1. The salary reductions include a 10 per cent cut in all pay checks of $150 or more monthly. Those receiving $90 or less are not affected and a smaller reduction than 10 per cent will be made in the pay of those receiving between $90 to $150. Combination of offices of division and construction and maintenance engineers will eliminate six jobs and effect a salary saving of $18,000.

Los Angeles to Build Reservoir in Bouquet Canyon

Construction of a new regulating reservoir in Bouquet Canyon, 60 miles from Los Angeles, Calif., has been begun by the municipal department of water and power to replace the storage and regulating capacity lost through destruction of the St. Francis dam. The Bouquet Canyon reservoir and dam, to provide 30,000 acre-ft. of storage, will cost $3,500,000. Plans call for an earthfill dam 210 ft. high.

Program of Public Works Urged Before Meeting of Taylor Society

SPEAKING before the Taylor Society, an international organization devoted to problems of administration and management, at its meeting held in New York on April 14, Virgil Jordan, economist, McGraw-Hill Publishing Co., and William T. Foster, economist and business writer, both declared that the only way out of the depressed condition in which the country finds itself, short of a revolution, is to spend large sums in the construction of public works and social facilities. Mr. Foster stated that we could spend $1,000,000,000 in 48 states on work that is ready to go. This is definite inflation, he admitted, but stated that as we have had two years of just as definite deflation the country could stand it.

Both speakers placed no faith in shorter working hours as a means in itself of offsetting the recurrence of the depression. Dr. Jordan said that shorter hours would stimulate the use of machines to supplant hand labor and Mr. Foster pointed out that unless the consuming power of the man whose hours are shortened is maintained conditions would not be improved. Leisure time, he said, is not legal tender.

Dr. Jordan, in recommending that federal credit be used for new public services for collective consumption, stated that he preferred to see it extended to states and municipalities for needed public works such as water supply, sewage disposal, playgrounds and highways through a Federal Construction Corporation. He would put a graduated tax on incomes that would practically confiscate the larger ones, would tax gifts and estates heavily, would abolish corporation taxes and tax the surpluses of corporations and the dividends they pay to other corporations. Individual and corporate surpluses must be largely diverted to consumers through taxation, he said, before they get back into investment. People with large incomes are an insignificant part of the consumer market; the real market is the small-income class. This is the class whose capacity for consumption must be preserved.

If we ever reach the saturation point in the construction of public works, money can be spent in the destruction of property to create parks and arterial streets and parkways and in clearing out the "rotting centers" of our cities. Public provision for housing of the lower-income group is inevitable, Dr. Jordan believes.

Problems of Smaller Industries to Be Studied

Encouraged by the interest shown in the first conference of smaller industries at Silver Bay, on Lake George, N. Y., last year by President Hoover and state and federal officials and industrialists generally, the board of directors of the Silver Bay Industrial Institute has decided to conduct a yearly conference on smaller industries, it is announced by Charles R. Towson, secretary of the Institute. From July 8 to July 22 special training courses will be given on plant training, industrial supervision and personnel under a faculty composed of outstanding managers and superintendents.

This year the smaller industries conference will be held from July 11 to July 16 and the program will be presented in the main by leaders of industry who represent the plant operation and the policy-making responsibilities of the large number of industries having fewer than 500 employees.

Explosion Damages Nearly Completed State Office Building at Columbus

Nine workmen killed and 53 injured when explosion attributed to gas in basement wrecks lower two floors and blows out partitions in every floor of twelve-story structure—Steel frame uninjured

THE new state office building in Columbus, Ohio, was seriously damaged by an explosion about 2:40 Thursday afternoon, April 14. A large number of workmen were in the building at the time, engaged in completing the interior decorating and installing fixtures. Seven men were killed and two more have since died of injuries; 53 were more or less seriously injured.

The cause of the explosion has not been definitely determined, but indications point to gas entrapped in a sub-basement, without outlets except two manholes, which occupied an irregular area about 30x60 ft. under the middle of the building. Floors, walls and trim in a portion of the lower two stories were wrecked and partitions were blown out on every floor. The structural steel frame escaped serious injury. The following account was provided by Clyde T. Morris, professor of structural engineering, Ohio State University.

The building, which was scheduled to be turned over to the state by the contractor on May 15, cost about $4,000,000 and is situated in the heart of the city facing the new Scioto Boulevard, on the east bank of the Scioto River, between Broad and Town Sts. The main structure is twelve stories high, covering an area about 70x410 ft. with a two-story addition 45 ft. wide running the entire length on the west front. The structural frame is of steel incased in concrete, and the floors are of reinforced-concrete pan construction. The exterior walls are of hollow tile faced with Georgia marble and the interior partitions are of hollow tile. The bays are 16½ ft. wide longitudinally of the building and from 17 to 28 ft. long in a transverse direction. All floor girders are of steel incased in concrete. Spread footings are used on a good clay gravel sub-soil.

Photos from Columbus Dispatch

New twelve-story state office building in Columbus, Ohio, which was seriously damaged by an explosion from an unknown cause but attributed to gas.

The center of pressure from the explosion seems to have been just west of the main bank of elevators in the sub-basement. The basement floor overhead was entirely blown off, as was the central portion of the first floor, covering an area about 70x160 ft. In this area the concrete floors were raised clear of the supporting steel girders and then fell back into the basement, leaving the girders with a portion of the fireproofing still adhering to them.

There are two banks of four elevators each, on either side of the main corridor, which runs the full length of the building. The force of the explosion traveled up these elevator shafts, blowing out the partition walls on both sides in every story. The pressure thus released wrecked many of the interior partitions on every floor. The damage decreased in extent toward the top of the building, but considerable damage was done even on the top floor.

In the lower two stories the windows and doors on the west side were all blown out, taking the metal frames and sash with them. The west wall in these two stories is bulged, and in two bays much of the marble facing is entirely down, while in the others it is cracked and partly displaced.

With the exception of a few beams in the basement floor and the light framing around the elevator shafts, the structural steel frame is uninjured. A careful examination of the columns and girders, especially at the girder connections to the columns, fails to reveal any signs of cracking of the concrete fireproofing even at points where the damage to the floors was greatest. This would indicate that the steel frame is intact.

One remarkable fact is the completeness with which the concrete floors were destroyed by pressure from below. The concrete slabs were lifted bodily away from their reinforcing rods, leaving these almost as clean as new rods. There is no indication of injury to the foundations or to the concrete piers which are below the basement floor level.

On west front of building force of explosion shattered the marble exterior facing in the lower two stories.

Basement over sub-basement, where explosion is believed to have originated, bore the brunt of the force. View shows wreckage, including debris from first floor above, which was lifted clear of its supporting steel frame and dropped into basement.

Washington Notes

By Paul Wooton
Washington Correspondent

AN AMENDMENT providing for the predetermination of wages was added to the prevailing-wage law by the Senate on April 18. Before becoming finally effective this amendment must be accepted by the House. According to members of the House committee that deals with labor legislation, action in that body is somewhat doubtful. Under the amendment, the secretary of labor is directed to determine the wage rates existing in the various sections before contracts are let by the executive departments. The amendment further provides that the advertised specifications for all contracts in excess of $5,000 for building construction work shall contain a statement of the wages to be paid. If the work contemplated by the contract requires more than three months for its completion, the secretary of labor is instructed upon the request of interested parties to reexamine the wage scale to see whether or not adjustments up or down are necessary. Adjustments in the wage scales that may be ordered by the government would be accompanied by corresponding adjustments in payments to the contractor.

Opposition was expressed by representatives of the American Federation of Labor during committee hearings. They asserted that predetremination would amount to fixing wages in private industry and would therefore be unconstitutional. In this connection, it was stated that an Illinois law providing for predetermination of wage rates was declared to be unconstitutional immediately after enactment.

In support of the measure, representatives of contractors and other witnesses who testified, cited numerous instances in which there has been confusion under the present prevailing-wage law, which does not require the determination of wages until after there has been a dispute following the award of a contract. Col. George B. Walbridge, chairman of the legislative committee of the Associated General Contractors, told the committee from his own experience about the uncertainties of the present law. He stated that he had been awarded a contract for the foundations of the post office building in Detroit. After work was started on the wage scale as agreed to by labor organizations, the government ordered an increase. It is business suicide to work under such conditions, he stated. In reply to the statement that the Illinois law providing for predetermination was held unconstitutional by the courts, Mr. Walbridge stated that this action was taken not because of the wage provision that was written into it but because of its indefiniteness.

Regulation of Buses and Trucks

Trucks in regular interstate operation would be required to obtain "certificates of necessity and convenience" but the bus business would be subject to more complete regulation under the recommendations submitted to Congress this week by the Interstate Commerce Commission. The need for truck regulation has been shown, according to the commission, but its advice to Congress is to make haste slowly. Pointing to practical and legal difficulties that surround truck regulation, the commission advocated the permit system as a means of obtaining information from interstate truck operators that would be helpful in pointing the way to actual regulation of their business. With reference to regulation of the trucks' use of the highways, the commission repeated its recommendation that Congress authorize a "special and intensive" investigation of taxation to determine whether the trucks are subsidized; to consider also, for the sake of uniformity, whether the federal government should fix the size, weight, load and speed of trucks and other requirements necessary to protect the public safety. Delegation of authority over trucks and buses to joint commissions set up by state regulatory commissions where possible also is recommended.

Road Bills Held Up

With the revenue and economy legislation absorbing most of the interest in Congress, little consideration has been given either the emergency or the regular road bills. The status of the emergency bill, which carries $132,000,000, continues unchanged.

Bids Received for El Capitan Dam

Bids for the construction of El Capitan dam were opened April 11 by the San Diego (Calif.) city council. The H. W. Rohl and T. E. Connolly Co. of Los Angeles submitted the low bid of $2,332,800. Other bids submitted were: The Utah Construction Co., $2,594,050; the Northern States Construction Co. and Butler Bros., $2,852,965; L. E. Dixon and Hall-Johnson Co., $2,999,260; and Foley Bros. and Lawler & Maguire, $3,633,271.50. The bids were well within the limits of estimates for the project, the latest estimates of the water bureau for this construction being between $2,250,000 and $2,500,000.

The bids were used on a rockfill dam 197 ft. high across the San Diego River approximately 25 miles from the city.

March Building Permits Show Slight Increase

Building permits reported for the month of March show a slight increase over permit figures for either January or February, but are much below those reported for the same month last year. March permits show a loss of 69 per cent from the 1931 figures. For the first quarter of 1932 building permits are 64 per cent off from the same period last year. The following table shows the building permit figures as reported by 50 representative cities and those estimated for the entire country based on a per capita extension of figures reported by 50 cities to the urban population of the country. Actual permit figures shown were furnished by S. W. Straus & Co.

BUILDING PERMIT FIGURES
(Thousands of Dollars)

	Actual 50 Cities	Estimated Total for U. S.
March, 1931	$48,488	$177,000
March, 1932	14,993	54,900
Per cent loss	69	.....
First quarter, 1931	113,963	418,000
First quarter, 1932	41,679	152,500
Per cent loss	64	.....

Illinois Waterworks Men Hold Annual Meeting

Water-purification topics dominated the discussions held at the annual meeting of the Illinois section of the American Water Works Association at Urbana April 12 and 13. Special attention was given to the finer aspects of water treatment, such as softening and taste-and-odor control.

A proposed standard for quantitative odor determinations was presented by Charles H. Spaulding. Its use involves the diluting of the water under test with odor-free water until the odor is just barely apparent. The reciprocal of the dilution at that point is used as a measure of the odor intensity.

Aeration and the relative values of the various aeration methods were discussed by Jack J. Hinman. One of the important considerations in studies of aeration, the effect of water temperature, has been given little attention heretofore. In the experiments now being made at the University of Iowa it has been observed that the temperature drop accompanying aeration, due to evaporation, is of importance in governing the amount of oxygen absorbed by the water.

The cost of hard water, in terms of the value of the extra soap consumed, was described in a paper by H. W. Hudson and A. M. Buswell. Their study was based on a survey of the amount of soap sold by retailers in Chicago Heights and Bloomington, Ill. The softening plant recently put into operation at Western Springs was described by D. M. Maxwell.

Chicago's plans for filtration of its Lake Michigan supply were discussed by A. E. Gorman. In view of the city's present prodigal use of water, the filtration program hinges upon effective metering. F. G. Gordon described the new filtration plant at St. Joseph, Mich.

John R. Baylis of Chicago was elected the new chairman of the section. Next year's meeting will be held in Chicago.

Hoover Dam Notes

Removal of the invert sections in the inlet end of tunnel No. 4 and at both ends of tunnel No. 1 was started at Hoover Dam during the week ended April 9. Pouring of the invert section was started in tunnel No. 4. At the end of the week 171 ft. of invert had been poured in that tunnel, 200 ft. in tunnel No. 3 and 672 ft. in tunnel No. 2. Two thousand yards of concrete was placed in the invert of tunnel No. 2 and 1,100 yd. in the invert of tunnel No. 4.

• • •

The concrete mixing plant was operated on a three-shift basis throughout the week. Approximately 1,500 cars of aggregates were shipped from the Arizona deposits. Operations at the screening plant have been placed on a two-shift basis.

• • •

Division of the working force, according to a check made on April 7, when 3,042 men were employed, was as follows: in tunnels, including truck and shovel operations, 1,108; on miscellaneous work at the river, 758; on the Nevada spillway, 199; on the Arizona spillway, 51; on mechanical and electrical work, 464; on railroad and gravel plants, 214; on Boulder City construction and general work, 244. These figures do not include 384 men employed by subcontractors.

Canadian National Railways Reduces Working Force

In accordance with the policy of strict economy rendered necessary by the decrease in revenue, the Canadian National Railways is largely reducing the working forces in shops. Vice-President Hungerford states that including those laid off last month the total number to be discharged would be about 4,000. A new rule has been adopted under which all foreigners who have not taken out naturalization papers will be dismissed regardless of seniority.

Check of Housing Needs Urged to Stabilize Construction

An inventory of local construction conditions, especially of residential shortages or surpluses, is proposed to the National Conference on Construction by its committee on business reports, statistical and trade information, in a preliminary report entitled Local Construction Inventories published recently.

This document is the first made public by the organization formed a year ago under the sponsorship of Robert P. Lamont, secretary of commerce, and Julius H. Barnes, chairman of the board of directors of the Chamber of Commerce of the United States. The committee on business report, statistical and trade information is under the chairmanship of S. L. Andrew, chief statistician of the American Tel. & Tel. Co., and includes the following men from the construction field: T. L. Condron, Condron & Post, Chicago; Willard T. Chevalier, publishing director, *Engineering News-Record;* Thomas S. Holden, vice-president, F. W. Dodge Corp.; A. D. Morehouse, chief of the construction section, Bureau of Census; Jordan A. Pugh, Common Brick Mfrs. Assn. of America; C. Stowell Smith, National Lumber Mfrs. Assn.; Kenneth K. Stowell, editor, *The Architectural Forum,* and Leonard C. Wason, vice-president, Aberthaw Co.

"Fact finding," says the report, "has been suggested as one method of stabilizing construction and realty values. If facts which indicate probable future demands are secured, it may be possible to regulate the volume of building so that the supply of structures will not greatly exceed the demand for them."

The report deals mainly with residential building, and the greater part of it is given over to a detailed description of how to make an occupancy-vacancy survey. The report does, however, touch upon the compilation of vacancy surveys of non-residential structures, and methods of analyzing population changes, business activity, income data, construction activity, mortgage and realty activities, building material and wage costs, and speculative activities as factors in drawing conclusions from occupancy-vacancy surveys. Certain ratios are set out as valuable in interpretation of such statistics, but the report emphasizes the fact that no factual data can be substituted for judgment.

Copies of the report may be obtained from the National Conference on Construction, 1615 H St. N.W., Washington, D. C.

Unemployed to Build Sewers in Johnstown, Pa.

Approval has been given by the mayor and city council of Johnstown, Pa., of a plan proposed by the bureau of engineering whereby emergency work will be provided for about 1,000 men for three or four months. Of a bond issue of $800,000 authorized in 1927, $200,000, for sanitary sewers, has not been issued. The plan of the engineering bureau is to issue these bonds and apply the proceeds to the construction of these sewers, of which about 25 miles remains to be built. Based on current prices of materials and a rate of 40c. an hour for unskilled labor, it is estimated that about half the proposed sewers can be built with the bond proceeds. Materials will be bought on competitive bids, but 90 per cent of the money will be for labor.

With the exception of several large sewers, where the necessity of considerable equipment makes the contract system advisable, the work will be done by hand labor under the supervision of the bureau of engineering. Employment will be restricted to citizens, with preference to those having dependents.

Nassau County, N. Y., to Issue $5,000,000 Public-Works Bonds

Issuance of $5,000,000 bonds to bear interest at not more than 6 per cent has been voted by the board of supervisors of Nassau County, N. Y. The proceeds of the issue, which will be offered within 30 days, will be used for these projects: $1,660,000 for the erection of the Meadowbrook Hospital, at East Meadow; $2,500,000 for land to continue the Northern State Parkway along the north shore into Suffolk County; $250,000 to build a new wing to the Nassau County Tuberculosis Sanitarium at Farmingdale; $590,000 for road improvement. The rest will go into the county treasury.

Authority on Earthquakes Dies in Japan

Kyoji Suyehiro, director of the Earthquake Research Institute and professor of applied mechanics at Tokyo Imperial University, Japan, died in Tokyo on April 9. Dr. Suyehiro was well known in this country. Only last fall he spent considerable time here lecturing in California and on the east coast. At that time he was in such poor health that he was unable to fulfill many requests to speak before engineering and scientific organizations.

Dr. Suyehiro was a graduate of the Tokyo Imperial University. While there he engaged in special studies in vibration which laid the foundation of his future work. Leaving the university for a time, he became a member of the engineering staff of the great shipbuilding works at Nagasaki, only to return to become professor of mechanical engineering and later of naval architecture, being called into consultation on shipbuilding problems. His studies in ship design and the effect of wave action led him into studying the propagation of earthquake waves and their effect on buildings, studies which led to the organization of the Earthquake Institute and the extensive studies of earthquake phenomena that have been carried on under his direction.

Last fall in introducing Dr. Suyehiro to a group of engineers assembled to honor him in New York John R. Freeman stated that without doubt Dr. Suyehiro was the world's foremost authority on earthquake phenomena, especially as they affect engineering structures.

COSTS AND CONTRACTS

ENR Index Numbers

	Cost			Volume	
April,	**1932**	**153.12**	**March,**	**1932**	**97**
March,	1932	157.24	Feb.,	1932	105
April,	1931	191.63	March,	1931	278
Average,	1931	181.35	Average,	1931	220
Average,	1930	202.85	Average,	1930	260
Average,	1930	202.85	Average,	1930	260
1913		100.00	1913		100

This Week's Contracts

Heavy construction contracts reported by *Engineering NewsvRecord,* in the week of April 21, with some comparisons, total as follows:

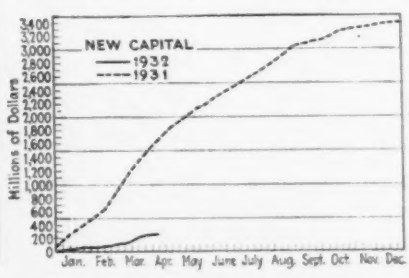
(In Thousands of Dollars)

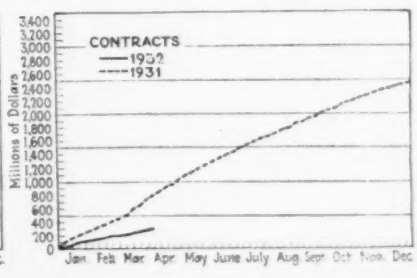
Engineering Construction	Week of April 21, 1932	Average Week April to Date	Average Week April, 1931
Federal government	$574	$2.455	$5.277
State and municipal	13.497	12.027	29.937
Total public	$14.071	$14.482	$35.215
Total private	10.530	8.171	28.166
Grand total	$24.601	$22.654	$63.381
Cumulative, all classes, Jan. 1 to April 21.			
1932			$321.596
1931			926.769

Capital and Contracts

Issues of new capital in the week ended April 16 totaled $13,000,000—all in public bonds. In the week of April 9 a total of $10,000,000 was split evenly between private and public financing. The weekly average for March, however, was $30,000,000 and in April, 1931, $111,500,000.

The cumulative total, Jan. 1 to April 16, inclusive, is $254,000,000, compared with $1,540,000,000 in the same period of 1931.





Personal Notes

F. ELMO BAKER has been appointed city engineer and water commissioner of Fulton, Mo., to succeed Philip D. Thurmond.

J. S. ERVIN, long an active figure in the building materials end of the steel business, has been elected president and a director of the Mackintosh-Hemphill Co., of Pittsburgh.

E. A. WOOD and W. J. POWELL announce that they have formed the partnership of Wood & Powell, consulting and city planning engineers. The headquarters of the firm will be in Dallas, Tex.

LAURENCE V. FRAZIER, lieutenant colonel, Corps of Engineers, district engineer at Jacksonville, Fla., has been transferred to Fort Humphreys, Va., as assistant to the commandant of the engineer school.

WILLIAM M. LABASTILLE is now employed by the Missouri state public service commission as assistant engineer and is assigned to the St. Louis office.

N. ROSE, bridge and building supervisor, Southern Pacific Co., Portland, Ore., division, who has been employed by the company for 36 years, retired from active service on March 31.

FLOYD J. PITCHER has been appointed engineer of structures of the New York, New Haven & Hartford R.R., vice Paul B. Spencer, who died recently.

CALEB MILLS SAVILLE, manager and chief engineer of the water bureau of the Metropolitan District Commission, Hartford, Conn., has been awarded the president's premium of £10 by the Institution of Water Engineers, of England, for his paper "Modern Dam Construction," presented before the summer meeting of the Institution at Harrogate, England, last May. The premium, which usually takes the form of instruments and text books, will be presented at the meeting in Sheffield on May 18.

C. W. WANZER, for fourteen years an engineer with the Oregon state highway department and for the past eleven years in charge of district No. 4, resigned last month on account of ill health. He is succeeded by K. D. LYTLE, formerly resident engineer for the department at The Dalles.

W. D. ELLISON, assistant drainage engineer of the bureau of agricultural engineering, U. S. department of agriculture, is now stationed in Dover, Del., in charge of the work for the bureau, in cooperation with the State of Delaware, of compiling information on channel maintenance work. Previously Mr. Ellison was engaged in conducting drainage investigations for the bureau at Bowling Green, Ohio.

DAVID MCCOACH, JR., major, Corps of Engineers, has been relieved from duty in the office of the district engineer, Detroit, Mich., effective about Aug. 1, and has been ordered to Vicksburg, Miss., for duty as assistant to the president of the Mississippi River Commission and assistant to the division engineer of the Lower Mississippi Valley Division.

HOMER W. CLARK, secretary of the engineering firm of Hubbell, Hartgering & Roth, has been appointed a member of the Detroit water board, succeeding Alex Dow, president, Detroit Edison Co., who has resigned after serving as the engineering member and president since 1916.

LUNSFORD E. OLIVER, major, Corps of Engineers, who has been instructor at the engineer school at Fort Humphreys, Va., has been assigned to duty at Vicksburg as secretary of the Mississippi River Commission and assistant to the president of the commission. PAUL S. REINECKE, who has held the position to which Major Oliver has been assigned, has been transferred to to engineer school at Fort Humphreys, Va., as a member of the faculty.

Obituary

TRACY B. SMITH, civil engineer at the Barge Canal Terminal, Rochester, N. Y., died on April 3 at his home in that city after a year's illness. Mr. Smith had been with the New York state engineering department since 1896.

WILLIAM NEWTON AGNEW, traffic manager of the Worthington Pump & Machinery Corp., New York City, since 1910 and also assistant to the president for the past three years, died suddenly on April 12. Mr. Agnew was 56 years old.

CHARLES H. KEEFER, of Ottawa, Ont., construction engineer, died on April 12 at the age of 80. Mr. Keefer, in the early days of his engineering career, was employed on railroad and bridge construction work in Canada, and since 1894 had been in general practice in Ottawa.

F. A. DUNHAM, for 61 years active as a civil engineer, died on April 18 at his home in Plainfield, N. J., at the age of 82. Mr. Dunham served at various times as Union County engineer and city engineer of Plainfield and of Dunkirk, Olean and Hornellsville, N. Y.

Dr. C. HAMPSON JONES, for a quarter of a century head of Baltimore's health department, died on April 11 from a heart attack, at the age of 73. Dr. Jones had served Baltimore as health commissioner or assistant health commissioner since 1898, except for the period from 1915 to 1919, during which time he was chief of the bureau of the state department of health.

Sir PATRICK GEDDES, of Edinburgh, Scotland, one of the most active promoters of city planning, died on April 17 in Montpelier, France, at the age of 78. His reconstruction of old Edinburgh, wiping out many of the slums and laying the way for the eventual elimination of all of them, attracted worldwide attention in the closing years of the last century.

CHARLES H. HOLMES, chief engineer of the Alaska Railroad, died at Anchorage, Alaska, on April 9. Mr. Holmes, a native of Lexington, Ky., was graduated from the Military Academy at West Point and entered the service of the Alaska Railroad in 1915, becoming successively bridge engineer and chief engineer. At one time he was the acting general manager of the road.

WILLIAM E. FISH, veteran engineer, died recently in a hospital in Chatham, N. B. For seven years Mr. Fish had been in the hospital with a fractured spine, sustained in a fall in a coal mine in 1925. He was 80 years old. After his graduation from the civil engineering school at McGill University Mr. Fish was engaged for two years surveying the boundary line between the United States and Canada and in the course of the work walked from Lake Superior to the Pacific coast. For the last 30 years he practiced as a consulting engineer in the Province of Quebec.

SOCIETY CALENDAR

AMERICAN SOCIETY FOR TESTING MATERIALS, annual meeting, Atlantic City, June 20-24.

AMERICAN SOCIETY OF CIVIL ENGINEERS, annual convention, Yellowstone National Park, July 6-9.

AMERICAN WATER WORKS ASSOCIATION, annual convention, Memphis, Tenn., May 2-6.

AMERICAN WELDING SOCIETY, annual meeting, New York City, April 27-29.

NEW ENGLAND SEWAGE WORKS ASSOCIATION, annual meeting, Boston, April 25.

SOCIETY FOR THE PROMOTION OF ENGINEERING EDUCATION, 40th annual meeting, Oregon State College, Corvallis, June 29-July 1.

LOS ANGELES ENGINEERING COUNCIL OF FOUNDER SOCIETIES has recently been organized. The preamble to its constitution is identical with that of American Engineering Council. Robert Linton is president, Carl Johnson vice-president and L. W. Voorhees secretary-treasurer.

MATERIALS HANDLING INSTITUTE has completed the program for its meeting in Detroit May 5. During the same week will be held sessions of the American Foundrymen's Association, the Hoist Builders Association, the Three M Congress (which covers management, maintenance and materials handling), groups of the A.S.M.E. and the waste elimination section of the A.S.M.E.

METROPOLITAN SECTION, American Society of Civil Engineers, met in New York City on April 20. The subject discussed was "Sewage-Disposal Problems in the Metropolitan District," and the speakers were Leonard L. C. Smith, engineer member of the Sanitary Commission of New York City; Charles A. Holmquist, director, division of sanitation New York State Department of Health, and Gerald W. Knight, secretary, Tri-State Pollution Commission.

MOHAWK VALLEY ENGINEERS CLUB, of Utica, N. Y., at its meeting on April 13 heard an address by Ely C. Hutchinson, editor of *Power*, on "The Pure Air Movement and the Engineer."

NEW ENGLAND SEWAGE WORKS ASSOCIATION will hold its fourth annual meeting in Boston on April 25. On the program are papers on "Industrial Wastes in Relation to Sewage Treatment," by Stuart E. Coburn, Boston; "The South Essex, Mass., Sewerage System," by Bayard F. Snow, Boston; "The New Canaan, Conn., Sewage-Treatment Plant," by J. G. Albertson, New York City; "Observations of American and Canadian Sewage-Treatment Plants," by Edward Wright, Boston. There will be a round-table discussion on screens, removal of oil and grease, operation of small treatment plants, and separate sludge digestion. At the annual dinner Prof. John W. M. Bunker, department of biology and public health, Massachusetts Institute of Technology, will deliver an address on "Stream Pollution and Self-Purification."

PENNSYLVANIA WATER WORKS OPERATORS ASSOCIATION will hold its fifth annual conference at State College, June 20-22. The conference of the Pennsylvania Sewage Works Association will follow the meeting of the waterworks association.

Construction Equipment and Materials

Aftercooler for Portable Air Compressors

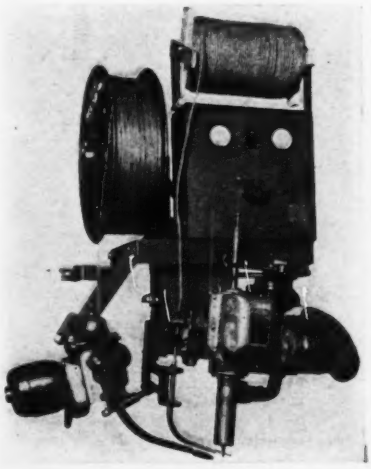
A patent for an aftercooler adaptable to portable air compressors has been granted to H. Druschel, manager, O. K. Clutch & Machinery Co., Columbia, Pa. It is claimed that this new type aftercooler will reduce the temperature of the air from 250 deg. to 115 deg., or more than 50 per cent. The

aftercooler is now under production and will be standard equipment on all O. K. compressors. The accompanying illustration shows it mounted on an O. K. portable compressor.

Automatic Welding Head Feeds Filler Metal Into Shielded Arc

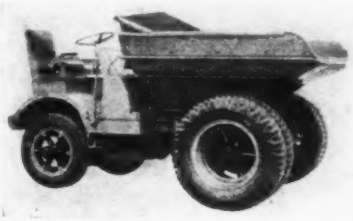
A wire feeding head which allows automatic arc welding with the shielded arc process has been developed by the Lincoln Electric Co., Cleveland, Ohio. The result claimed for this head is a very high speed operation on butt, fillet or building-up welding, the deposited metal having physical characteristics equal to or better than mild steel. The shielded arc technique is secured through the use of the Electronic Tornado welding head and a fibrous autogenizer which is fed into the arc flame. This autogenizer burns and forms a gas excluding the oxygen and nitrogen of the atmosphere while the metal is molten. The welding head utilizes a carbon arc, around which is superimposed a magnetic field which directs the arc stream on the line of fusion. The filler metal carries no current and its size is independent of the current used for welding. Means are provided for varying the speed of the travel of the head and of the rate at which the filler metal is fed into the arc. It is claimed that with this method of welding tensile strengths from 65,000 to 80,000 lb. per sq.in. are obtained, with a ductility of 20 per cent or more elongation in 2 in.

New shielded arc wire feeding automatic arc welder.



4-Yd. Dirt-Hauling Unit

Designed for use on dirt-hauling jobs where tractive ground conditions permit the use of wheels, the Koehring Wheel Dumptor provides low-cost operation at high speed. Built by the Koehring division of the National Equipment Corp., Milwaukee, Wis., it has a load-carrying capacity of 4 cu.yd. Features of the new Dumptor are the concentration of a relatively small load on large tires with excess motor power, a short wheelbase, instantaneous front gravity dump and spreading type body. The rig has three speeds forward



Koehring 4-yd. Dumptor.

and three speeds reverse, permitting shuttle operations on most hauls. The 85-in. wheelbase permits turning on a 13-ft. radius. The hopper dumps at an angle of 90 deg., and an automatic kick-out pan insures clean dumping. Steel wheels 24 in. in diameter may be interchanged with the pneumatic lug type tractor tires. The entire machine is designed to withstand the rigors of dirt hauling.

Business Notes

MONTREAL LOCOMOTIVE WORKS, LTD., Montreal, will manufacture and sell self-propelled rail units in accordance with the engineering and specifications of the J. G. Brill Co. of Philadelphia; a complete line of process plants and equipment for the oil-refining industry, using the patents and processes controlled by Alco Products, Inc., New York, and a complete line of modern diesel engines, in accordance with the designs and patents of the McIntosh & Seymour Corp., of Auburn, N. Y. The works will continue to manufacture and sell steam, electric and diesel locomotives as heretofore.

F. H. BURLEW CO., 221 West Huron St., Chicago, announces that it has taken over the business of the R. H. Hyland Co., as dealer in railroad, contractors' and industrial equipment and supplies.

PARKER, DANNER CO., 4 Northampton St., Boston, has been organized by Alfred B. Parker and William A. Danner to supply contractors' equipment and tools to the New England territory.

BONNEY FORGE & TOOL WORKS, Allentown, Pa., announces the appointment of G. Fred Sherman as manager of sales of the forged fittings division.

AMERICAN LEATHER BELTING ASSOCIATION, 41 Park Row, New York, has decided that for the greater protection of the consumers of leather belting this commodity should be sold by specifications of thickness instead of weight, thereby discarding the old weight terminology of ounces per square foot, which may be varied by the mere addition of weighting materials to the leather, and does not necessarily always represent a differential in transmission values. Standard thickness specifications have been set up for first-quality leather belting.

LINDE AIR PRODUCTS CO., 205 East 42d St., New York, has produced a two-reel film showing the Lindeweld process and its application in the construction of a 20-in. natural gas line. This new film, as well as other Linde motion pictures, is available for showing before engineering and technical societies, and other technical and industrial groups. Films are loaned free of charge and are available in both 16-mm. and 35-mm. sizes.

New Publications

Auto Road Graders—The Caterpillar auto patrol, its construction and use, are fully described in a 22-p. booklet issued by the Caterpillar Tractor Co., Peoria, Ill.

Heavy Grading Equipment—A new 24-p. catalog issued by R. G. LeTourneau, Inc., Stockton, Calif., describes in detail the construction and operation of LeTourneau control units, bulldozers, scrapers, rooters, rollers, dump carts and cowdozers.

Concrete Ashlar Walls—Portland Cement Association, 33 West Grand Ave., Chicago, is distributing a new 16-p. booklet describing a recently developed type of masonry construction known as concrete ashlar walls. The booklet is illustrated with views of various installations of this type of masonry, in both interior and exterior walls, in residences, schools and other buildings.

Airport Lighting Equipment—A 16-p. bulletin issued by the General Electric Co., Schenectady, N. Y., describes various types of electrical airport lighting equipment complying with airport rating regulations of the aeronautics branch of the U. S. department of commerce.

Pressure Control—An interesting device known as the Thrustor which produces a straight-line constant pressure thrust from an electric motor drive is described in bulletin GEA-1262B issued by the General Electric Co., Schenectady, N. Y. The Thrustor unit has two general fields of application: (1) to supply pressure and actuate lower mechanisms; (2) to replace muscular effort with electrical control on foot- or hand-operated machines. In the construction field it is applicable to hoist engine brakes, to storage bin gates and to pipe line valve operation.

Hydraulic Dredging Plant—Morris Machine Works, Baldwinsville, N. Y., describes a full line of hydraulic dredging plants for sand and gravel production in its new bulletin 144.

Portable Crushing and Screening Equipment—Bulletin W32-A, issued by the Austin-Western Road Machinery Co., 400 North Michigan Ave., Chicago, describes two new portable crushing and screening plants for sand and gravel production, known as Model 100 and Model 90. The two plants are identical except for the inclusion of an extra crusher and screen on the Model 100.

Tools—J. H. Williams & Co., 75 Spring St., New York City, have published the 21st edition of their complete catalog, 216 pp., describing a full line of tools, including new drop forgings and drop-forged tools, socket wrenches and chain pipe tongs.

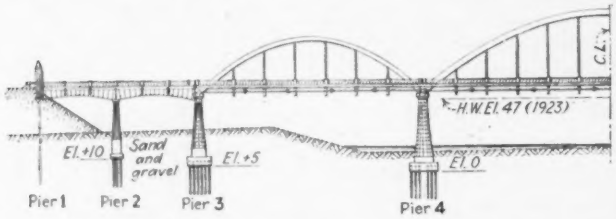
Cast-Iron Pipe Formula—Illustrated discussion of the modified Fairchild formula for determining metal thickness for cast-iron pipe is a feature of a new booklet, "Specifications for Acipco Mono-Cast Centrifugal Cast-Iron Pipe, Bell-and-Spigot, 1932," now being distributed by the American Cast Iron Pipe Co., Birmingham, Ala. The new booklet is occasioned by the recently promulgated federal specifications for bell-and-spigot cast-iron pipe in which certain revisions of former requirements are contained.

Current Construction Unit Prices

Clackamas River Bridge, Oregon City

CLACKAMAS River Bridge, one mile north of Oregon City on the East Portland-Oregon City highway, has three tied steel arch spans and two concrete approach spans. Center span is 242 ft. 2½ in. long, side spans 142 ft. 6½ in. each, approaches 101 ft. 6 in. each, total length 730 ft. Width is 52 ft. c. to c. trusses, roadway 48 ft. The concrete piers are seated on piles in gravel and yellow clay. Piers 4 and 5, supporting the center span, are 50 ft. high from bottom of footing, which is 18x20½ ft. in plan by 6 ft. thick.

Concrete is of three classes: A, for beams, brackets, pier caps and pylons; B, for pier footings, shafts and web walls between piers; D, for piling, roadway slab and curb, and sidewalk slab.



Three-span highway bridge over Clackamas River, Oregon.

Ten bids were received and unit prices are given of the lowest three: (A) Lindstrom & Fiegenson, Railway Exchange Bldg., Portland, contract; (B) Pacific Bridge Co., Portland; (C) Gilpin Construction Co., Portland.

	A	B	C
2,200 cu.yd. excav.	$5.00	$2.25	$3.50
9,000 lin.ft. timber found. piles	.40	.45	.42
1,600 lin.ft. conc. found. piles	2.00	3.50	2.50
440 cu.yd. seal conc.	10.00	7.50	9.00
1,260 cu.yd. cl. B conc.	11.00	14.00	11.00
580 cu.yd. cl. A conc.	14.00	18.00	15.00
1,130 cu.yd. cl. D conc.	12.00	16.00	14.50
358,000 lb. reinf.	.03½	.037	.03½
1,500 lin.ft. conc. hand rail	3.00	3.25	4.00
Structural Steel			
1,100,000 lb. med. open hearth, except floor beams, stringers	.053	.053	.055
678,000 lb. above for floor beams and stringers, Alt. A	.045	.042	.04½
532,000 lb. silicon steel, for above, Alt. B	.061	.048*	.061
Alt. A	165,475.00	169,603.00	171,515.00
Alt. B	167,417.00	166,663.00	171,762.00

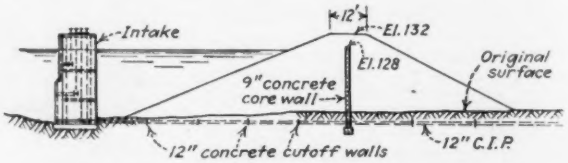
*Heat-treated instead of silicon.

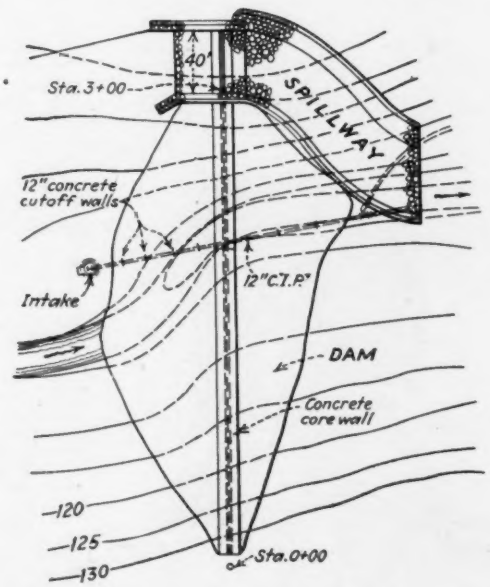
North Creek Water Supply, N. Y.

AN EARTH DAM and storage reservoir was placed under contract in March, 1932, by the North Creek Water District to furnish water to the hamlet of North Creek and Holcombville, N. Y. The dam is 280 ft. long by 120 ft. wide at base and 39 ft. high. It has a wall 263 ft. long by 35 ft. high and 9 in. thick. Reservoir area of 5 acres, formed by damming Roaring Brook, a subtributary of the Hudson River, has a capacity for 20 million gallons. Work includes also a 100,000-gal. steel storage tank, 6¼ miles of 6-8-in. cast-iron mains, a chlorinator, an automatic pressure control and relief valves for an 8-in. cast-iron supply main 2 miles long. There are five contracts, as follows: dam and pipelaying, $37,308, Henry Dumary, Albany; cast-iron pipe, $16,420, R. D. Wood & Co., Philadelphia; valves, $1,049, Michigan Valve Mfg. Co., Detroit; hydrants, $1,697, Ludlow Valve Co., Troy; tank, $1,830, Chicago Bridge & Iron Works, Chicago.

Principal contract unit prices were 50c. per cubic yard for the earth embankment, $15 for the concrete core wall, 45c. to 50c. per linear foot for laying 6- and 8-in. pipe, 50.65c. per foot for 22,750 ft. class 150 centrifugal pipe. Contract unit prices are given below.

6 in. laying B&S. lead, 5 ft. tr. 12 ft., 6,000 ft	$0.50
6 in. laying B&S. leadite 5 ft. tr. 12 ft., 6,000 ft.	.48
6 in. laying B&S. lead, 5 ft. tr. 16-18 ft., 6,000 ft.	.47
6 in. laying B&S. leadite 5 ft. tr. 16-18 ft., 6,000 ft	.45
8 in. laying B&S. lead 5 ft. tr. 12 ft., 14,000 ft.	.55
8 in. laying B&S. leadite 5 ft. tr. 12 ft., 14,000 ft.	.53
8 in. laying B&S. lead 5 ft. tr. 16-18 ft., 14,000 ft	.52
8 in. laying B&S. leadite 5 ft. tr. 16-18 ft., 14,000 ft.	.50
8 in. laying B&S. lead 3½ ft. tr. 12 ft., 11,325 ft.	.48
8 in. laying B&S. leadite 3½ ft. tr. 12 ft., 11,325 ft.	.46
8 in. laying B&S. lead 3½ ft. tr. 16-18 ft., 11,325 ft.	.45
8 in. laying B&S. leadite 3½ ft. tr. 16-18 ft., 11,325 ft.	.40
6 in. laying universal pipe, 6,000 ft.	.40
8 in. laying universal pipe, 14,000 ft.	.45
8 in. laying universal pipe, 11,325 ft.	.35
Earth embankment, 14,000 cu.yd.	.50
Earth excavation core wall, etc., 115 cu.yd.	1.00
Concrete — core wall, 185 cu.yd.	15.00
12 in. laying B&S. lead — under dam, 204 ft.	.70
Flashboards — complete	50.00
Extra concrete in place, 1:2:4	15.00
Extra concrete in place, 1:3:5	12.00
Extra earth excav. and backfill	2.00
Extra rock excav. and backfill	5.00
Extra lumber in place	50.00
6 in. pressure reducing valves, 6	200.00
2 in. pressure relief valves, 12	30.00
Pipe, complete job:	
12 in. Class B B&S, 204 lin.ft.	1.178
6 in. Class 150 centrifugal, 16-18 ft., 6,000 lin.ft.	.3587
8 in. Class 150 centrifugal, 16-18 ft., 22,750 lin.ft.	.5065
8 in. Class 200 centrifugal, 16-18 ft., 2,500 lin.ft.	.5567
Class D metropolitan flexible joint, 60 lin.ft.	1.854
B&S specials, 10 tons	75
Flanged end specials, 4.5 tons	115
Valves:	
6 in. hub end standard gate valves, 11	12.20
8 in. hub end standard gate valves, 19	17.0
12 in. hub end standard gate valves, 1	38.0
6 in. flanged end standard gate valves, 18	12.97
12 in. flanged end standard gate valves, 4	39.85
2 in. screwed end standard gate valves, 6	4.50
6 in. hub end standard hydrants, 35	48.48
Storage tank	1,830.00





Plan and cross-section of dam on Roaring Brook, North Creek, N. Y.